# REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release or
Threatened Release of Hazardous Substances in Region 5

**FINAL BASIS OF DESIGN REPORT**
**Revision 1**
Old American Zinc Plant Superfund Site
Fairmont City, St. Clair County, Illinois
Facility Area Remedial Design
WA No. 224-RDRD-B5A1/Contract No. EP-S5-06-01

March 2019

Parts of this document have been redacted to protect personally identifiable information.

PREPARED FOR

U.S. Environmental Protection Agency

PREPARED BY

ch2m

FOR OFFICIAL USE ONLY

FINAL BASIS OF DESIGN REPORT

# Old American Zinc Plant Superfund Site
# Fairmont City, St. Clair County, Illinois

## Facility Area Remedial Design
## WA No. 224-RDRD-B5A1/Contract No. EP-S5-06-01

Parts of this document have been redacted to protect personally identifiable information.

*Prepared for*

Revision 1
February 2019

# Professional Engineer Certification Statement

I certify that this document and all appendixes and attachments, as applicable, were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons that manage the system or of persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

| | |
|---|---|
| Name of P.E.: | Matthew Gavin |
| Registration No.: | 062-056650 |
| Date: | February 22, 2019 |

Affix Stamp & Signature of Registered P.E.

Matt Gavin
2/22/2019

LICENSED PROFESSIONAL ENGINEER
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# Acronyms and Abbreviations

| | |
|---|---|
| ARAR | applicable or relevant and appropriate requirement |
| BODR | basis of design report |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| CH | fat clay (soil classification) |
| CH2M | CH2M HILL, Inc. |
| COC | contaminant of concern |
| CWA | Clean Water Act |
| EPA | U.S. Environmental Protection Agency |
| FA | facility area |
| FS | feasibility study |
| IAC | Illinois Administrative Code |
| NC | normally consolidated (soil classification) |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | National Resource Conservation Service |
| NRHP | National Register of Historic Places |
| NWP | Nationwide Permit |
| QAP | construction quality assurance/quality control plan |
| OAZ | Old American Zinc |
| OC | overconsolidated (soil classification) |
| PRP | potentially responsible party |
| RA | remedial action |
| RAO | remedial action objective |
| RCRA | Resource Conservation and Recovery Act |
| RD | remedial design |
| RI | remedial investigation |
| ROD | Record of Decision |
| SWPPP | stormwater pollution prevention plan |
| SPT | standard penetration test |
| TCRA | time-critical removal action |
| USACE | U.S. Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| XTRA | XTRA Intermodal, Inc. |

SECTION 1

# Introduction

The U.S. Environmental Protection Agency (EPA) contracted CH2M HILL, Inc. (CH2M) to prepare the remedial design (RD) for the Facility Area (FA) at the Old American Zinc (OAZ) Plant Superfund Site, consistent with the Record of Decision (ROD) (EPA 2012). This revised final basis of design report (BODR) was prepared to address contaminated soil at the FA and soil received from offsite properties surrounding the FA. The report is completed in accordance with Work Assignment No. 224-RDRD-B5A1 under Contract No. EP-S5-06-01 and *Old American Zinc Plant Superfund Site, Fairmont City, St. Clair County, Illinois, Remedial Design Work Plan* (CH2M 2017), the ROD (EPA 2012), and the *Remedial Design/Remedial Action Handbook* (EPA 1995).

## 1.1 Site Description

The OAZ Superfund Site is located in the Village of Fairmont City in St. Clair County, Illinois. The site includes a 132-acre FA and surrounding properties (Figure 1-1) where elevated metal concentrations associated with the facility operation were found in different media. The FA is bordered by several commercial and industrial properties, including Garcia Trucking to the west, CSX Intermodal railroad yard to the south, and General Chemicals to the east. Rose Creek is an ephemeral creek present at the southern boundary of the site. A portion of the site is within the 100-year floodplain (Figure 1-2), and based on National Wetland Inventory mapping, the site contains wetlands. Figure 1-2 also shows several drainage ditches that are present onsite, along with Rose Creek.

## 1.2 Site History

OAZ conducted zinc-smelting operations at the site from 1916 to 1967. Slag from the smelting operation was cooled by placing the molten material along the northern and western boundary of the FA. The slag stock piles originally encompassed an area of 15 acres. The site, including the clinker and other smelting residues on the property, was purchased by XTRA Intermodal, Inc. (XTRA), in 1979. XTRA operated a trucking terminal at the site until 2003 that included lease, storage, and maintenance of a diverse fleet of trailers. XTRA ground and redistributed the slag stockpiles on the FA to buildup and level the former plant site to facilitate its trucking operation. At present, redistributed slag on the FA cover an area of 125 acres with thickness ranging from 6 inches to 9 feet (ENTACT 2012).

Site investigations conducted at the site since 1994 detail the nature and extent of contamination in the FA and surrounding properties. ENTACT completed a remedial investigation (RI) and feasibility study (FS) for the site in 2012 and identified contaminants in different media that included slag stock piles, ground slag that was used as fill material, high metal concentrations in shallow groundwater in the FA, and small localized instances of tar-like materials (tarry material) assumed to be residual products historically used at the FA, including asphaltic tars or asphaltic grouts commonly used in brick structures exposed to high heat.

The impacted surrounding areas include residential, commercial, and vacant properties and village alleyways and drainageways that were contaminated with runoff from the facility. Ground slag was also transported to offsite properties by local businesses, residents, and the Village for surfacing village alleyways and used as fill material in residential properties (ENTACT 2012). Most of the impacted properties are located to the west of the site, with small pockets of trailer park and residential developments to the north, south, and east.

EPA, under the provisions of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), conducted a time-critical removal action (TCRA) from 2002 to 2003. A total of 462 offsite properties was sampled during the TCRA, of which 209 properties were found to have lead concentrations above the Remedial Action Level of 400 parts per million. Impacted soil was removed from 152 properties, with the remaining properties to be addressed under future remedial action (RA). Following the completion of the RI/FS in 2012, a ROD was issued by EPA detailing the selected remedial approach for the site. EPA entered into an Administrative Order on Consent with the potentially responsible party (PRP) in August 2014 to perform the RD work. The PRP was tasked with performing the RD work, and a draft final RD report (consisting of the report, selected drawings, but no technical specifications) was submitted to EPA in April 2016. In April 2016, the entity responsible for the PRP's work filed for Chapter 11 bankruptcy and ceased performing additional work at the site. As a result, EPA took control of the site to complete the RD.

CH2M previously performed oversight at the OAZ site on behalf of the EPA and has been tasked with completing the RD activities under WA No. 224-ROBE-B5A1.

## 1.3 Selected Remedy and Remedial Action Objectives

EPA's selected remedy for the site is Alternative 4A, as described in the ROD (EPA 2012). The overall strategy for the site is to contain and cover the low-level-threat waste in order to reduce future human health and ecological risk to acceptable levels.

The selected remedy for the FA involves removal of vitrified slag, redistributed ground slag, and affected soils and sediments within the FA, removal of source material (slag used as fill) and placing within a 35-acre consolidation area located in the southwest portion of the FA. Contaminated soil from the identified residential, commercial/industrial, vacant properties, or village alleyways above the applicable residential or commercial/industrial human health cleanup levels will also be placed in the consolidation area. Tarry material will be placed in the consolidation area, as it was previously tested and determined to be nonhazardous. The consolidation area will be capped with a cover system consisting of a 24-inch low-permeability clay barrier, overlain by a 12-inch vegetative soil cover. An Environmental Covenant will be placed on the groundwater and soil as an institutional control.

Remedial action objectives (RAOs) were created for source materials, affected soil/sediment, and for groundwater both on the FA and surrounding properties. For each media, the RAOs were designed to address potential human health and environmental risks with direct exposure to contaminants of concern (COCs) in media. RAOs are presented in their entirety in Section 2.8 of the ROD (EPA 2012). Final cleanup levels are presented in Section 2.12.4 of the ROD (EPA 2012) and summarized in Table 1-1.

Table 1-1. Final Cleanup Levels
*Old American Zinc Superfund Site Facility Area*

| Contaminant of Concern | Soil/Sediment | | | Groundwater |
|---|---|---|---|---|
| | Residential (mg/kg) | Non-Residential (mg/kg) | Commercial/Industrial Worker (mg/kg) | MCL/Illinois Class I (mg/L) |
| Arsenic | 32 | 239 | 239 | 0.01 |
| Cadmium | 37 | 809 | 135 | 0.005 |
| Lead | 400 | 826 | 826 | 5 |
| Zinc | 6,400 | 31,852[a]/306,600[b] | 51,100 | 0.15 |

[a]Based on ecological risk for sediment
[b]Based on human health risk for soil/sediment

## 1.4 Remedial Design Activities

RD activities to support implementation of the selected remedy have been outlined in EPA's Statement of Work dated December 14, 2016, attached to the Initial Work Assignment Form, dated December 21, 2016. The activities included in the design include the following:

- Project Management and Reporting
- Subcontractor Procurement and Support Activities
- Prefinal/Final design
- Technical and Post-RD support

Project management, community involvement, and post-RD support are efforts that are required to manage the work and support EPA in related activities.

The following appendixes are included in this report:

A Slope Stability Calculations
B Stormwater Design Calculations
C Old American Zinc Facility Area Design Specifications
D Construction Quality Assurance Plan
E Operations and Maintenance Plan
F Engineer’s Estimate of Construction Cost
G Drawings
H Agency Consultation
I Institutional Controls and Implementation Plan

CH2M will provide general technical support for the site during the RA/construction phase, as stated in the *Remedial Design Work Plan* (CH2M 2017).

SECTION 2

# Project Delivery Strategy

Section 2 presents the project delivery strategy for the remediation at the FA. The RA consists of excavating slag and source material from the FA and placing excavated material into a newly constructed consolidation area. The consolidation area will be capped with a cover system consisting of a 24-inch low-permeability clay barrier, overlain by a 12-inch vegetative soil cover.

## 2.1 Remedial Design

Implementation of the RA will consist of several components, including general activities for the project, and property-specific activities. Although some of the components will occur concurrently, the general sequencing of the primary components will be as follows:

- Procurement.
- Submittal of plans outlined in the specifications and any other required action submittals.
- Initial surveying/staking and preconstruction activities.
- Mobilization/staging in areas as shown in Figure 2-1.
- Clearing and grubbing.
- Fence repair, replacement, and/or installation.
- Decommissioning of excavation-conflicting monitoring wells.
- Coordinating with other contractors to identify staging area(s) and stockpile locations.
- Installation of erosion and sediment controls near all soil disturbance areas, including excavation areas and all stockpiles. Erosion and sediment controls requirements will be described in a soil erosion and sediment control plan, which will be included in the stormwater pollution prevention plan (SWPPP).
- Excavation and stockpiling of an initial amount of source material from the footprint of the new consolidation area to be constructed. Stockpile excavated source material in the northwest portion of the site adjacent to the existing slag stockpile as shown in Figure 2-1.
- Excavation of source material in areas of the site that the contractor deems as most suitable for optimizing minimal handling and that are out of the way of construction to create stockpile areas for clay for the cover and general site fill.
- Excavation of unimpacted clay from the consolidation area to design grades and stockpiling the clay. Clay meeting the requirements of the low-permeability cover shall be placed in an area separate from clay material that is not accepted for capping the consolidation area (general fill).
- Excavation of source material from the FA and placement of material into the consolidation area, along with previously stockpiled material, and excavated soil from surrounding properties.
- Covering the consolidation area with low-permeability cover and vegetative layer.
- Grading, including filling and cutting, FA to design grades using general fill clay.
- Site restoration.
- Demobilization.

Detailed drawings (Appendix G) and specifications (Appendix C) have been prepared as part of the RD. As part of the RA activities, the RA contractor will be required to present a detailed work plan to the owner's representative describing how the work will be executed.

## 2.2 Remedial Action

Roles during the RA will be defined as follows:

- Owner: EPA, Region 5
- Engineer: CH2M
- Property Owner: XTRA
- Owner's Representative: construction management firm, or U.S. Army Corps of Engineers, which the EPA has contracted to complete the RA
- RA Contractor (contractor): Responsible for completing work described in the contract documents, and management of all subcontractors
- Subcontractor: A subcontractor retained by the contractor

The procurement strategy for implementing the RA includes planning, contractor prequalification, submittal of a Request for Proposals, evaluation of the proposals, submittal of the Request for Consent, contract award, and contract management.

Some of the design specifications for the project may be performance-based. This type of contract allows the contractor the flexibility to provide innovative and cost-effective solutions to the project. To provide prospective contractors with sufficient time to review the existing data and develop their proposals, the solicitation process will begin following approval of the final design document.

Although the property owner for the purposes of this RA is XTRA, there are several parcels within the project area that are not owned by XTRA. These parcels are owned by residents, St. Clair County, and the Village of Fairmont City, among others. Before work proceeds, access will be obtained from all property owners for every parcel included in the work.

## 2.3 Procurement Activities

The owner's representative will solicit separate contracts for select components of the RA. The components include, but are not limited to, earthwork, surveying, and restoration under a single contract, to be performed by the primary contractor (hereinafter referred to as contractor). Although the contractor may choose to subcontract portions of the project, in this document "contractor" will refer to the primary RA contractor.

Procurement of contractors will be completed prior to commencing construction activities. Contractors for the RA activities are expected to be competitively procured, and procurement activities for the surrounding properties will be independent of any procurement activities for the FA.

Contracts will be competitively bid among qualified businesses that are able to meet the technical, safety, and schedule requirements. Under the RA, potential bidders will be prequalified from various sources, including a diverse supplier database and the EPA Region 5 Small and Disadvantaged Business Utilization Coordinator.

The solicitation documents will include instructions to bidders, project specifications, drawings, proposed contract agreement (including EPA Prime Contract flow-down provisions), and other forms for bidders to complete. Proposals will be evaluated, and award(s) will be made to the successful bidder(s).

SECTION 3

# Basis of Design

Section 3 presents the technical details and assumptions of the RD.

## 3.1 Subcontracting

Procurement of subcontractors will be completed prior to commencing construction activities. Subcontractors for the RA activities are expected to be competitively procured among qualified businesses that are able to meet the technical, safety, and schedule requirements, and subcontracts are independent of any RA activities to be performed for the surrounding properties.

## 3.2 Preconstruction

Preconstruction work includes preparation of site plans and other submittals, identification of clean borrow sources for topsoil, and coordination with St. Clair County and affected utility companies. The work will be conducted prior to contractor mobilization.

### 3.2.1 Design Assumptions

#### 3.2.1.1 Site-specific Plans and Preconstruction Submittals

CH2M has drafted a construction quality assurance/quality control plan (QAP; Appendix D) which provides detailed guidance for implementation of quality processes and procedures during construction operations. A site-specific health and safety plan will be prepared by the contractor. The health and safety plan will outline procedures to be followed so that the work is completed safely and with no adverse health effects to workers or the community.

A draft SWPPP, which includes a soil erosion and sediment control plan, will be prepared and provided by the contractor with information specific to their approach during the RA as a means to describe the potential sources of stormwater pollution at the site, describe practices to reduce pollutants in stormwater discharges from the site, and identify procedures they will implement to comply with the substantive requirements of Illinois General National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Discharge from Construction Site Activities (Illinois General NPDES Permit; Illinois Environmental Protection Agency 2014). Substantive requirements of Illinois General NPDES Permit ILR10 (IEPA 2018) will be adhered to, including inspections by a qualified person (that is, Professional Engineer, Certified Professional in Erosion and Sediment Control, Certified Erosion Sediment and Stormwater Inspector, or other knowledgeable person) who possess the skills to assess conditions at construction sites that could impact stormwater quality and assess effectiveness of any sediment and erosion control measures implemented. The qualifications of the qualified person will be in accordance with the requirements of Illinois General NPDES Permit and 40 *Code of Federal Regulations* Parts 121 and 122.

A technical report of the wetland survey performed per the specifications will be submitted by the contractor. This will include the delineation methodology, results of the delineation, photographs, GIS shapefiles, a U.S. Army Corps of Engineers (USACE) Jurisdictional Determination Form per the USACE *Jurisdictional Determination Form Instructional Guidebook* (May 30, 2007), background information, Clean Water Act (CWA) analysis, and data sources. In addition, the contractor will prepare and submit a Nationwide Permit (NWP) 38 Substantive Requirements Document documenting how the remediation project will address each requirement in the NWP 38 Cleanup of Toxic and Hazardous Waste.

The contractor will verify compliance with the substantive requirements of applicable regulations. The contractor will also deliver applicable preconstruction submittals to the owner's representative and/or engineer for approval before mobilization. Preconstruction submittals include site-specific plans (including waste management plan, erosion and sedimentation control plan, and a dust control and monitoring plan), a detailed project schedule, and identification of source materials as required in the specifications (Appendix C) and identified in the QAP (Appendix D).

Additional plans and preconstruction submittals will be prepared as outlined in the specifications.

#### 3.2.1.2 Wetlands Delineation

A wetland delineation will be performed prior to any activities. Protocols and methods are outlined in the specifications (Appendix C).

#### 3.2.1.3 Staging Area

The contractor will establish a staging area according to the equipment, materials, and facilities required for RA. Existing buildings will not be used for staging. The FA has adequate area to store material and equipment, house temporary field offices/trailers, and establish equipment decontamination facilities. Prior to establishing or expanding staging areas, permission must be granted by the property owner, the area must be tested, appropriate accommodations must have been made in writing allowing the property owner to access their existing facilities, and the location must be approved by the Owner’s Representative.

Staging areas delineated in site support drawings and in Figure 2-1 are assumed as reasonable locations and are to be used for planning purposes only. These locations do not exempt the contractor from performing requirements for setting staging-area limits. The contractor will coordinate the staging area location(s) with other contractors onsite.

## 3.3 Initial Mobilization

Initial mobilization includes that of the contractor. Design assumptions are discussed in the following subsections.

### 3.3.1 Design Assumptions: Contractor Mobilization

Initial mobilization will consist of the following, as needed:

- Obtain access for several parcels within the project area that are not owned by XTRA. These parcels are owned by residents, St. Clair County, and the Village of Fairmont City, among others. Before work proceeds, access will be obtained from all property owners for every parcel included in the work.
- Constructing temporary facilities such as field office/trailers, material storage facilities, and equipment decontamination facilities
- Placing stabilized construction entrance material at the construction entrance
- Placing gravel at storage, laydown, and staging areas for erosion and sediment control, and if necessary, for grade in designated areas
- Delivering equipment
- Placing erosion and sediment control features, such as silt fencing, for all stockpile and staging areas
- Documenting any measures necessary to comply with location-specific applicable or relevant and appropriate requirements (ARARs) such as the Migratory Bird Treaty Act
- Documenting the condition of the FA and haul route with pictures

Equipment to be used by contractors are expected to be transported by road. The contractor will provide and maintain required temporary facilities for the duration of the project, along with a field office/trailer.

Temporary utilities will be active for the duration of the project, plus an additional 1 week at the start and end of construction.

### 3.3.2 Design Assumptions: Site Access/Security and Coordination

Access control to the site during construction is necessary to prevent exposure of non-RA personnel to contaminated soil. Access will be controlled by maintaining fencing around the FA and updating where needed. Typical working hours for construction activities will be 7:00 a.m. to 6:00 p.m., Monday through Friday.

The FA, which is fenced, will be used as a staging area for the storage of equipment, stockpiling borrow material, staging excavated source material, decontamination facilities, and temporary field offices/trailers. A decontamination pad will be constructed for equipment decontamination.
The contractor will be responsible for security to monitor site equipment and the staging area during non-working hours. The contractor will maintain control over work areas during working hours at the site.

## 3.4 Site Preparation

Site preparation activities specific to the FA include installing erosion and sediment control measures and locating utilities. The contractor must coordinate with property owners prior to performing any work. Drawing C-002 of Appendix G contains property owner information.

### 3.4.1 Design Assumptions

#### 3.4.1.1 Preconstruction Survey

A preconstruction survey will be performed to document existing surface elevation and conditions and will be used during excavation and construction. The preconstruction survey may include migratory bird and Indiana bat habitat and protocols as described in Section 3.4.1.3. A post-reclamation survey will be performed after remediation to document the final conditions. Surveys will be conducted by an Illinois-licensed surveyor.

#### 3.4.1.2 Utility Locate

The one-call utility location system (JULIE) will be contacted and a third-party utility-locating service used to identify utilities within the FA before work begins. During the preconstruction property visit, the property owner will be interviewed to determine if there are any undocumented or private utilities on the property. The location of property-owner-identified utilities shall be confirmed using a third-party utility-locating service and other physical means at the property. The actual location of the utilities will be recorded on the property drawing for permanent documentation.

#### 3.4.1.3 Clearing and Grubbing

Clearing, grubbing, and removal of any vegetation or structures will be performed between September 11 and March 31 (outside of the migratory bird nesting season), over the entirety of the FA. If tree removal cannot be conducted within this timeframe, an additional evaluation for migratory birds will be performed, and protection measures will be implemented. Further, if trees greater than 4 inches in diameter must be removed between April 1 through September 30, potential roost trees for the Indiana bat will be visually assessed. If no bats are observed, clearing can commence. If bats are observed, tree removal will be postponed until after October 1, to the extent practicable. With the implementation of these conservation measures, the project is expected to have no adverse effect on threatened and endangered species or habitat that may occur at the site. Details for the clearing and grubbing are provided in the project specifications.

#### 3.4.1.4 Temporary Erosion, Sediment, and Nuisance Controls

Temporary erosion and sediment controls to minimize the transport of contaminated surface soils during the remedial action include temporary erosion control matting, silt fence, compost filter socks, and straw applications. The erosion and sediment controls will be constructed, inspected, and repaired or replaced as necessary during construction. This design contains proposed components to address erosion and sediment control, as shown in the drawings (Appendix G). In addition, a SWPPP is a contractor-required submittal prior to construction.

#### 3.4.1.5 Temporary Slopes

Temporary slopes may be created during the construction of the cover for the subgrade and compacted clay soil layers. Temporary stockpile areas created for placing excavated soils will have slopes that will require maintenance and erosion protection. The temporary slopes will be required to be maintained during construction and placement of the cover layers to minimize erosion. Imported material will be required to be certified clean and meet 35 Illinois Administrative Code (IAC) 1100, as outlined in the specifications.

#### 3.4.1.6 Sediment Barriers

Silt fences will be used to impede the flow and to provide for solids removal to reduce the transport of the sediment. These controls will be placed along the contours on long slopes and at the perimeters of the disturbance area, in places where temporary diversion berms cannot be used. Silt fence will be installed as shown on the drawings. Silt fence (or compost filter socks) will be installed at the base of consolidation area slope and at the top of temporary drainage ditch banks to prevent sediments from non-vegetated surfaces from migrating into temporary ditches. Silt fences will be maintained until site restoration is complete or until grading measures have removed their need. Erosion and sediment controls will follow the SWPPP, and the requirements and best management practices in Illinois General NPDES permit ILR10 (IEPA 2018) and in the Illinois Urban Manual.

#### 3.4.1.7 Stabilized Construction Entrances

The stabilized construction entrances will consist of stabilized stone to reduce the amount of soil removed from the construction site. The entrance will be repaired as necessary to maintain its effectiveness throughout the project.

#### 3.4.1.8 Dust Control and Monitoring

Dust control will be provided during excavation, consolidation, and soil cover construction activities to meet the substantive requirements of the fugitive particulate matter ARARs. Water for dust control may come from the onsite ponds, the municipal water system, or other local sources. An air monitoring plan, which includes perimeter air monitoring for site COCs, is required prior to construction.

#### 3.4.1.9 Noise Control

Equipment that complies with 35 IAC part 900 standards for noise will be provided, and daytime and nighttime noise levels at the site property line will be complied with to the extent practicable. If noise complaints occur, adjustments to the work schedule or operations will be developed thereafter.

#### 3.4.1.10 Permanent Erosion and Sediment Controls

Permanent erosion and sediment controls include established vegetation in ditches. Permanent vegetative cover will be used on the final at-grade soil surfaces. Soils will be seeded with native seed mixtures, depending on the temperature at time of planting. The final cover itself allows stormwater to drain to designed drainage structures.

# 3.5 Consolidation Area Construction

The descriptions of the steps necessary for the construction of the consolidation area are provided in the following subsections.

## 3.5.1 Description of Work

Excavation, transporting, stockpiling, grading, and compaction will be performed. Completion of excavation activities will require excavation of both slag and native clay by mechanical methods. The placement of the consolidation area is such that it will remain out of the 100-year floodplain as shown in Figure 3-1.

## 3.5.2 Design Assumptions

### 3.5.2.1 Estimation of Quantities

For estimation of quantities, geotechnical borings were advanced throughout the FA to determine slag and clay thickness. The depths of slag and clay were then interpolated between the boring locations, and an estimated required slab excavation quantity was determined using computer-aided design (CAD) software. Additional volume calculations were performed in CAD to determine the following quantities in cubic yards.

- Existing slag stockpile onsite: 33,500 cubic yards
- Slag excavated from the FA: 780,500 cubic yards
- Contaminated soil from offsite residential properties: 15,000 cubic yards (assumed)
- Consolidation Area design capacity: 974,000 cubic yards
- Clay excavated to construct consolidation area: 375,900 cubic yards
- Clay fill needed for low-permeability cover: 101,430 cubic yards
- Clay Fill needed for site restoration: 274,470 cubic yards
- Topsoil needed: 148,440 cubic yards

### 3.5.2.2 Surface Preparation

Preparation within the footprint of the consolidation area will be performed by mechanically excavating slag to an extent such that the compacted soil cover layer can be terminated on clean, stable soil. It may be necessary to over-excavate and backfill with general fill to accomplish this. The slag will be removed from the footprint to allow excavation of the entire cell floor to an elevation of 410 feet. Localized grading will be performed by the contractor to allow for proper drainage during construction.

Surface preparation may also be required in areas that will be used for stockpiling the clay that will be excavated from the consolidation area. These stockpile areas will be selected by the contractor and placed on site to optimize minimal material handling, and in locations out of the way of construction. Any slag excavated for these areas will be stockpiled in the northwest portion of the FA on or adjacent to the existing slag stockpile.

The contractor will perform post-excavation confirmatory sampling and visual observations to verify that all slag has been removed and that the underlying clay has not been impacted. Analytical testing will be performed on a grid with 200-foot centers at the bottom of excavation within areas of slag removal, for every 100 linear feet of ditch, and at outfall excavation(s) (to be included in the Field Sampling Plan).

If concrete foundations are encountered during excavations, the concrete will be completely removed, pulverized, and either placed in the stockpile along with the slag, or disposed of within the consolidation area after it is excavated.

Existing monitoring wells onsite may need to be decommissioned during excavation due to their location and the depth of anticipated excavation. These wells will be reinstalled near the original location once excavation and restoration are completed as shown in the drawings.

Dust abatement will be performed during excavation and transportation operations, in addition to the concrete pulverizing, as necessary to prevent emission of visible fugitive dust beyond the FA boundary. Activities may include a work stoppage until dust abatement measures are implemented.

#### 3.5.2.3 Stockpile Areas

Materials may be stockpiled separately onsite and managed in accordance with the SWPPP. Excavated slag from the FA will be placed on and adjacent to the existing slag stockpile in the northwest portion of the site. Other material that is excavated from the consolidation area will be stockpiled in two areas on site based on the intended use. The contractor shall select a stockpile location for the clay that will be used to cover the consolidation area that is separate from the stockpile location for the material that will be used as general site fill. These stockpile areas will be selected by the contractor and placed on site to optimize minimal material handling, and in locations out of the way of construction.

It is assumed that excavated contaminated soils from adjacent properties will be placed adjacent to the existing slag stockpile in the northwest portion of the site by others; however coordination between the FA and surrounding properties contractors will be required. All stockpiles will be inspected and maintained by EPA in accordance with the SWPPP until officially closed in accordance with 35 IAC 807.305(c).

The contractor will identify potential borrow sources of topsoil in their proposal within 5 days of Notice of Award. Prior to receiving the materials, the contractor will collect compliance samples of these materials and submit the samples for laboratory testing to verify that the material meets specifications and is appropriate for use. Continued compliance samples will be collected and submitted for laboratory analysis as identified in the specifications throughout the RA.

#### 3.5.2.4 Tarry Material

Tarry material may be present mixed with demolition debris and in localized areas across the footprints of former smelter buildings. Tarry materials were tested during the Preliminary Design Investigation and were determined to be nonhazardous. As a result, the materials will be disposed of in the consolidation area.

#### 3.5.2.5 Concrete Foundations

Several concrete foundations are present onsite, remaining from the former smelter buildings. The foundations will be exposed during excavation of the slag, and when encountered, they will be completely removed, pulverized, and will either be stockpiled with the slag in the northwestern portion of the site or placed directly into the consolidation area (after it is excavated).

#### 3.5.2.6 Surface and Excavation Water Management

Cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works may be constructed as necessary for the environmentally safe removal and disposal of water from the various parts of the Work. Building foundations and other parts of the Work will be maintained free from water. Surface water that must be re-routed will be pumped and will not be treated. Water from excavations or dewatering wells will be allowed to percolate into the ground where possible. Such pumped water that discharges to a ditch, creek, or surface water will meet the water quality standards in 35 IAC Section 302.208 and 302.210 and will be managed in accordance with a Dewatering Plan. A treatment system and associated discharge monitoring will be utilized, if necessary to meet these standards. Construction stormwater will be managed as described in Section 3.2.1.1.

#### 3.5.2.7 Consolidation Area Subgrade Preparation

After completion of the slag excavation in the consolidation area footprint, the underlying native soil will be excavated as shown in the drawings to construct the bottom of the consolidation area.
The approximate bottom elevation will be 410 feet. The subgrade will be compacted and proof rolled, and any remaining unsuitable soils below this elevation will be removed and replaced with suitable compacted fill. If voids are encountered during excavation, the voids shall be filled with suitable material and compacted according to the specifications. Excavated clay that satisfies specification requirements will be used use as the low-permeability cover system, and other excavated soils will be used for general site fill as discussed in Section 3.5.2.12.

#### 3.5.2.8 Placement of Slag Material

Slag will be excavated from the remainder of the FA not already excavated and will be placed within the consolidation area along with stockpiled slag and contaminated material from the adjacent residential properties. The FA RA contractor is responsible for placing all material into the consolidation area, including any new material from the residential area brought to the FA during the RA. The FA RA contractor may coordinate placement of material from the residential area with the with the surrounding properties RA contractor; however, for the purposes of this design, it is assumed that the FA RA contractor will place all material into the consolidation area. Wet material will not be placed in the consolidation area. With Owner Representative’s approval, sediment excavated from ditches to be placed within the consolidation area may be mixed with dry fill or backfill material to obtain an acceptable moisture content, as determined by the Owner’s Representative, for placement into the consolidation area.

The material will be placed in layers and compacted as described in the specifications (Appendix C). The material will be graded as shown in the drawings (Appendix G).

#### 3.5.2.9 Compacted Low-Permeability Cover Layer

A minimum 24-inch compacted low-permeability soil cover layer will be constructed on top of the prepared slag material. Geotechnical testing on clay obtained from the site indicates that the native clay is a suitable material for this purpose. Excavated clay from the consolidation area footprint meeting this criterion (as indicated by index testing) will be used for the cover. Any clay that does not meet the permeability criteria shall be used for site restoration as discussed in Section 3.5.2.12.

The layer will be placed and compacted as described in the specifications (Appendix C). The compacted soil cover layer will be constructed to the design grades shown in the drawings (Appendix G).

#### 3.5.2.10 Vegetative Soil Layer

Twelve inches of topsoil cover will overlay the consolidation area compacted and surface-roughened clay layer, per the ROD. The topsoil will be seeded and maintained to establish a vegetative cover as discussed in Section 3.6.

#### 3.5.2.11 Slopes

The slopes shown in the final cover grading plans are based on 10 to 1 (horizontal to vertical) slopes on the perimeter berms and a 3 percent slope on top of the cover. The final design slopes may be adjusted up or down to accommodate more or less waste quantity. Any changes to the consolidation area slopes shall be verified and approved by the engineer.

#### 3.5.2.12 Site Restoration

After the low-permeability cover is placed over the consolidation area and the entire site has been cleared of slag material, the existing grades will be leveled (where needed) in preparation for the placement of general site fill. The material from the general fill stockpile will be used to backfill to the design grades as shown in the drawings (Appendix G).

Sloped areas will receive surface roughening by tracking or similar methods to ensure adequate bonding with topsoil. In accordance with the ROD, 12 inches of topsoil will be placed above the 24-inch low-permeability clay cover within the consolidation area (for 36-inch total thickness). Outside of the consolidation area, 6 inches of topsoil will be placed above final subgrade design elevation. Topsoil areas will be restored as described in Section 3.6.

Regulated wetlands that are disturbed will be restored as determined by EPA and USACE.

#### 3.5.2.13 Material Balance

The consolidation area as designed can accommodate approximately 974,000 cubic yards and will contain all of the material from the site (stockpiled and slag), in addition to contaminated soil removed from the adjacent residential sites. The clay excavated in order to create the consolidation area will be stockpiled onsite as previously discussed and will be used completely in the restoration. As a result, there will be a net balance of materials, both slag and clay, onsite. Quantities of materials are discussed in Section 3.5.2.1 and are provided in the cost estimate in Appendix F.

#### 3.5.2.14 Air Monitoring

Real-time air monitoring for particulate matter will be conducted continuously at the FA while earthwork is being performed. Data will be recorded to a data logger once per minute and checked by personnel once per 30 minutes, in accordance with the QAP (Appendix D). The air monitoring equipment will be placed at locations to verify effectiveness of engineering controls in minimizing dust generation that may potentially leave the exclusion zone. Dust monitors will be placed by the contractor to determine the impact of the construction activities on air quality. One monitoring station shall be placed upwind, and three shall be placed downwind of earthwork activities at the FA, and locations shall be updated daily based on the activities performed and the predominant wind direction.

Dust-monitoring data will be evaluated against the EPA National Ambient Air Quality Standards for $PM_{10}$ of 1.5 milligrams per cubic meter. The standards are based on a 24-hour average, but active construction activities will only be performed for approximately 10 to 11 hours per day, so no dust generation is assumed during the non-working hours. During work hours, an alarm will be set at 0.75 milligrams per cubic meter to observe activities and determine the cause for elevated particulate concentrations and to evaluate potential mitigation measures to maintain the 24-hour average concentration below the criteria. Exceedances of the dust-monitoring criteria require dust abatement measures, typically application of water, or stop work and further evaluation.

Personal air sampling pumps will be used in conjunction with dust-monitoring equipment and will have samples collected for laboratory analysis to determine potential exposure to arsenic and/or lead. These samples will be representative of the worst-case exposure that may occur to any potential receptors outside of the excavation area, such as residents or pedestrians, from the excavation work. Based on the results of the first week of personal air sampling, the sampling plan will be reviewed to evaluate the monitoring program for the remainder of the field event. Factors that will be considered include, but are not limited to, the following: (1) results of the first round of personal air sampling, (2) level of soil contamination anticipated in future excavations based on previous soil sampling data, (3) soil conditions (wetness) anticipated, and (4) level of work activity anticipated.

### 3.5.3 Design Evaluations

Several design components are necessary to ensure the longevity of the consolidation area, including slope stability, settlement, soil loss, and stormwater calculations. The following subsections describe the individual calculations in detail and provide the results of the analyses.

#### 3.5.3.1 Consolidation Area Stability and Settlement Analysis

The consolidation area berm and cover system were analyzed for global stability using SLIDE version 7.0 by RocScience. SLIDE is a two-dimensional limit equilibrium slope stability program for evaluating the factors of safety against slope failure. Rotational (circular) and translational (block and non-circular) surfaces were evaluated using the Spencer method. Drained and undrained static, seismic (pseudostatic), and post-seismic conditions were evaluated.

Seismic (pseudostatic) analyses were performed using a conservative pseudostatic coefficient ($k_h$) of 50 percent of the peak ground acceleration for the 2,475-year return period earthquake (U.S. Geological Survey 2018). Strength-reduction factors were used for the pseudostatic and post-seismic analyses.

The cross section for analysis was selected along the southeast edge of the proposed area, which represents the maximum cell height and conservatively assumes that the perimeter ditch is at the toe of slope.

The calculated factors of safety for static, seismic (pseudostatic), and post-seismic were compared to a minimum factor of safety criteria of 1.5, 1.0, and 1.2, respectively, consistent with Illinois Environmental Protection Agency and EPA guidance. See Appendix A for stability analysis details and results.

**Subsurface Conditions and Soil Properties**

Limited geotechnical strength data are available for the proposed cell footprint, although general soil types and stratigraphy have been documented by previous borings and monitoring wells. Therefore, reasonably conservative drained and undrained soil properties were assumed, based on typical values for similar materials.

In March of 2009, ENTACT prepared an investigation report (ENTACT 2009), documenting an environmental field investigation performed between 2006 and 2008. One-hundred and twenty geoprobe borings between 4 to 16 feet deep, 7 hand auger borings between 3.5 to 6 feet, 10 wells between 16 to 24 feet deep, and 3 hollow stem auger borings up to 76 feet deep were used to prepare the stratigraphy within the facility.

The subsurface shown in Section A-A of the ENTACT investigation report (ENTACT 2009) consists of the following (from top to bottom):

- 4 to 8 feet of slag
- Approximately 15 feet of fat clay, silty clay, and clayey silt
- 10 to 20 feet of silt, sand, and mud
- 30 to 35 feet of fine sand and silt
- Fine to coarse sand

Based on monitoring well data, it is anticipated that the water table is about elevation 405 feet. For analysis purposes, the water table was considered at 415, near the bottom of the proposed perimeter ditch.

Geotechnical strength and consistency data in the ENTACT investigation report (ENTACT 2009) is limited to two borings with standard penetration test blowcounts (SPT N-values) reported for silt and sand below 20 feet below ground surface. These data indicate the deep silt and sand are medium dense (with SPT N greater than 20), but other soil boring log descriptions indicate that the shallower silt and sand could be in a looser condition. Index tests performed on clay samples from test pits indicate that fat clay (Unified Soil Classification System classification of CH) are common at the site.

Table 3-1 summarizes the selected geotechnical parameters for slope stability evaluations. Due to the limited amount of geotechnical strength and consistency data, conservative strength parameters were selected for the stability analyses. As discussed in more detail below, testing is recommended prior to consolidation area construction to confirm these parameters.

For seismic (pseudostatic) analyses, an undrained shear strength of 80 percent of the assumed static (peak) shear strength was assigned.

For post-seismic analyses, an undrained shear strength of 65 percent of the static (peak) shear strength was assigned for cohesive soils. For the saturated, potentially loose shallow silts and sands, a post-seismic shear strength ratio (Su/P') of 0.1 was conservatively assumed to account for the potential "worst-case" of liquefaction of this layer. For unsaturated or denser granular materials (compacted residuals and medium dense foundation sands), 80 percent of the static (peak) strength was assigned.

Table 3-1 lists soil parameters used in the global stability analyses.

Table 3-1. Geotechnical Engineering Strength Parameters by Stratum
*Old American Zinc Superfund Site Facility Area*

| Stratum | Description | Moist Unit Weight | Assumed Shear Strength Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Static | | | Pseudostatic | | | Post-Seismic Residual | | |
| | | $\gamma_m$ | c' | $\phi$' | $S_u$ | c' | $\phi$' | $S_u$ | c' | $\phi$' | $S_u$ |
| | | (pcf) | (psf) | (deg) | (psf) | (psf) | (deg) | (psf) | (psf) | (deg) | (psf) |
| Ia | Fill - Topsoil - Stiff | 130 | 0 | 25 | 1,500 | -- | -- | 0.8x $S_u$ | -- | -- | 0.65 x $S_u$ |
| Ib | Fill – Slag and Residuals | 120 | 0 | 23 | (drained) | 0 | 18.8 | (drained) | 0 | 18.8 | (drained) |
| Ic | Fill - Clay - Stiff | 128 | 0 | 20-29 | 1,000 | -- | -- | 0.8x $S_u$ | -- | -- | 0.65 x $S_u$ |
| IIa | Native - Clay - Stiff | 128 | 50 | 20-29 | 1,000 | -- | -- | 0.8x $S_u$ | -- | -- | 0.65 x $S_u$ |
| IIb | Native - Silt – V Loose | 115 | 0 | 24 | (drained) | 0 | 19.6 | (drained) | -- | -- | $S_u/\sigma_v'$=0.1 |
| IIc | Native - Sand - M. Dense | 125 | 0 | 29 | (drained) | 0 | 23.9 | (drained) | 0 | 23.9 | (drained) |

Notes:
$\gamma_m$ = moist unit weight
c' = effective cohesion
$\phi$' =effective friction angle
$S_u$ = undrained shear strength
$\sigma_v'$ = effective vertical stress
deg = degree
pcf = pounds per cubic foot
psf = pounds per square foot

### Results and Design Recommendations

Table 3-2 summarizes the resulting global stability factors of safety. Appendix A contains full results, including the SLIDE profiles. As shown in Table 3-2, all analyses satisfy the minimum factor of safety criteria based on the assigned soil strength parameters in Table 3-1.

While the assigned soil strength parameters are considered reasonably conservative for similar soils, limited geotechnical strength or consistency data is available within the cell footprint. Therefore, verification testing is recommended within the proposed cell footprint to confirm that the soil parameters in Table 3-1 are representative. This could be done by a grid of cone penetration test soundings around the perimeter of the proposed cell berm, possibly combined with a few samples collected for geotechnical analysis (index, strength, and consolidation tests). Appendix A contains a recommended grid of cone penetration test (CPT) sounding locations.

If cohesive soils with undrained shear strength lower than approximately 1,000 pounds per square foot are encountered below the proposed cell bottom elevation, the engineer should be contacted to evaluate cell stability and settlement and/or to recommend extents of additional removal and replacement.

Where sand or other cohesionless soils are present at the proposed cell bottom, approximately 2 feet of compacted clay should be placed over the base of the cell prior to placing residuals in those areas.

Table 3-2. Factor of Safety – Global Stability Analyses
*Old American Zinc Superfund Site Facility Area*

| Case | Shape of Slip surface | Factor of Safety |
|---|---|---|
| Static - Drained | Rotational | 2.61 |
| | Block | 4.19 |
| | Non-circular | 2.46 |
| Static - Undrained | Rotational | 4.44 |
| | Block | 5.36 |
| | Non-circular | 4.26 |
| Pseudostatic | Rotational | 1.33 |
| | Block | 1.31 |
| | Non-circular | 1.22 |
| Post-seismic Residual | Rotational | 1.88 |
| | Block | 2.09 |
| | Non-circular | 1.70 |

### 3.5.3.2 Settlement Analysis

Settlement of the final cover system was evaluated using Settle3D, version 4.016 by RocScience.
The maximum expected settlement under the consolidation area and final cover loads was calculated as the sum of immediate and consolidation settlement. A fill height of approximately 20 feet above surrounding grade was assumed.

Consolidation parameters for the potentially fat clay (CH) under the cell were selected to evaluate the range in possible settlement. Both normally consolidated (NC) and overconsolidated (OC) conditions were considered for settlement evaluations. Details on the settlement evaluation methods and results are included in Appendix A.

The estimated total settlement of foundation soils at the cell crest ranges from about 6 inches (for OC clay) to over 3 feet (for NC clay). Over the proposed cover slope length of about 500 feet from crest to perimeter berm, and assuming little settlement at the perimeter berm, this could correspond to about 0.7 percent decrease in the cover slope for NC conditions, some of which would develop during construction (prior to cover construction). If the clay is NC, the potential slope decrease should be accounted for in the constructed cover slope. The OC settlement estimate can likely be accommodated by the cover without modifying the slope. Note that if soil liquefaction were to occur during the design earthquake (after cover construction), additional settlement could develop, in which case localized regrading may be required to re-establish the cover slopes.

The verification testing recommended in Section 3.5.3.1 should include collection of data to confirm the preconsolidation condition (NC or OC) of the in situ shallow clay soils.

### 3.5.3.3 Soil Loss Equation

The Universal Soil Loss Equation was used to estimate the amount of soil that could be expected to erode from the site during construction in a typical year. The restored completely vegetated conditions yield a soil loss of about 1 ton per acre per year, not including erosion protection included in the design. Generally acceptable soil loss is less than 2 tons per acre per year, indicating adequate design.

The highest levels of erosion occur during the construction of the consolidation area. Erosion control measures as shown in the drawings will be required to manage the high levels volumes of soil loss that are expected. Appendix A contains the Universal Soil Loss Equation calculation package.

#### 3.5.3.4 Stormwater Calculations

Aside from the drainage for the constructed stream and wetlands, stormwater conveyance has been designed to promote runoff from the consolidation area cover system to the current drainage pathways.

**Surface Water Routing**

The design includes a stormwater management system designed to convey a 25-year, 24-hour storm to prevent flooding. Surface water runoff occurring within developed areas of the facility will be managed to control erosion, sedimentation, and stormwater discharges. Stormwater and erosion runoff will be as described in detail in the drawings and specifications. It will be controlled by using the following designed controls:

- Grass-lined perimeter ditches around the consolidation area, adequately sized to convey the 25-year, 24-hour storm event and designed to be stable consistent with National Resources Conservation Service (NRCS) Illinois Urban Manual Practice Standard, Grass Lined Channel Code 840.
- Silt fencing and erosion matting during construction.
- Vegetative buffers between construction and stormwater channels, if available.

Stormwater runoff was estimated using methods described in the U. S. Department of Agriculture, NRCS, Conservation Engineering, Division, Technical Release 55 (TR-55), Urban Hydrology for Small Watersheds (June 1986). Calculations for the TR-55 methods were performed using WIN TR-55 with Soil Conservation Service methodology hydrologic modeling and use of WIN TR-55’s dynamic routing capabilities for hydraulic calculations. The adequacy of the perimeter ditches around the consolidation area to convey the 25-year, 24-hour storm event was verified in U.S. Army Corps of Engineers HEC-RAS hydraulic engineering software, version 4.1.0. Stormwater calculations are provided in Appendix B.

In general, surface water on site flows from the top of the cover in all directions and down the 10 to 1 (horizontal to vertical) slopes to perimeter surface water ditches. Grass-lined ditches were designed with grass lining and seed mixes generally conforming to the NRCS Illinois Urban Manual Practice Standard Code 840. The geometry of the ditches is generally a trapezoidal section with a variable bottom width and sideslopes of 3H:1V or flatter. The depths of the ditches vary from 1.5 to 5.5 feet, depending on the location and the amount of runoff the ditch will receive. During small precipitation events, runoff from the consolidation area will be maintained within a shallow (~1 foot deep) swale along the southern toe of slope, and Rose Creek will be maintained within a shallow (~2 feet high) berm on the north side of the creek. During higher precipitation events, the shallow swale and berm are designed to overtop, such that the wider area between the toe of slope and Rose Creek will act as a large trapezoidal ditch.

Temporary stormwater management will include ditches and temporary check dams. Temporary sediment controls are described in Section 3.4.

## 3.6 Restoration

Restoration work includes seeding and placement of erosion control materials over the entirety of the disturbed area, including the consolidation area.

### 3.6.1 Seeding and Mulching

After placement of topsoil, the entire site will be seeded and mulched as described in the specifications (Appendix C).

### 3.6.2 Erosion Control

After seeding and mulching, the site will be covered with erosion-control matting as described in the specifications and as shown in the drawings.

### 3.6.3 Wetland Restoration

The contractor will restore wetlands and other waters of the United States, if required based on input from EPA and other regulatory agencies, and the results of the wetlands and other waters delineation that the contractor performs per Section 02 24 00, Delineation of Wetlands and Other Waters of the United States (Appendix C).

### 3.6.4 Warranty Period

The restoration subcontractor will warranty the seeding and replace bare spots, if necessary, as identified within the warranty period and the project specifications. Watering after replacement will be provided by the property owner.

## 3.7 Post-construction Survey

A post-construction survey will be conducted to after reclamation is complete. The survey will serve to document the new site conditions to assist in monitoring the consolidation area.

## 3.8 Demobilization

Demobilization will include removal of the temporary facilities such as field trailer, utilities, material storage facilities, equipment decontamination facilities, and erosion and sediment control features. Until site restoration and demobilization are completed, construction oversight should be performed to will verify that erosion and sediment control features comply with the SWPPP.

The excavation and hauling equipment will not leave the site during excavation and transportation, so decontamination is not necessary until the equipment leaves the site. Wet decontamination shall be performed on all trucks that hauled contaminated soils, prior to final demobilization.

## 3.9 Post-construction Documentation

The owner's representative will prepare an RA completion report, including an ambient air monitoring report. The RA completion report will document the work completed by the owner's representative and its subcontractors using a report format in accordance with *Close Out Procedures for National Priorities List Sites, OSWER Directive 9320.2-22* (EPA 2011).

## 3.10 Operation and Maintenance

Institutional controls, in accordance with the Illinois Uniform Environmental Covenants Act will be put in place at the FA to achieve the following: (1) prohibit future residential land use on the 35-acre consolidation area and select onsite and offsite properties that are not likely to be used for future residential development, (2) control access to engineered components of the remedy and prohibit intrusive activities in capped areas to maintain the effectiveness of the cover, and (3) prohibit the installation of potable wells and use of shallow groundwater within the affected groundwater plume until all groundwater cleanup standards have been achieved to ensure long-term protection of human health.

- Surface water monitoring will be performed to verify the effectiveness of the remedy on reducing transport of COCs via stormwater runoff to the manmade ditches. Groundwater monitoring will also be performed. Sample locations will be selected after completion of the RA and detailed in a Surface Water and Groundwater Monitoring Plan.

- A groundwater management zone will be established pursuant to regulations in the Illinois Administrative Code related to Groundwater Quality (35 IAC, Subtitle F, Chapter I, Part 620). Groundwater monitoring will be performed, to ensure that COCs in shallow groundwater are not migrating off the FA at concentrations exceeding upgradient concentrations. If a statistically significant increase in groundwater concentrations is observed over time, the remedy will be re-evaluated.
- Engineering controls will be implemented for the buildings and parking lots shown in Figure 2-2.
- Appendix I contains a draft Institutional Controls and Implementation Plan. The entity implementing the institutional controls will work with the EPA to finalize the plan during the RA.

Continued inspection and maintenance are needed to ensure the longevity and integrity of the cover on the consolidation area. These activities will commence immediately following completion of the remedial action and will include inspecting the cover for damage (punctures, failures, and erosion), inspecting and maintaining erosion control, identifying vegetative stress and correcting as needed, mowing the vegetative cover, and ensuring institutional controls are in place. Monitoring reports will be prepared annually, and a site performance review will be performed every 5 years. The long-term maintenance plan provided in Appendix E specifies the requirements for the inspection, maintenance, and reporting.

SECTION 4

# Compliance with Applicable or Relevant and Appropriate Requirements

This project is being performed in accordance with the CERCLA ROD for OAZ (EPA 2012). Under CERCLA, a requirement under environmental laws may be either applicable or relevant and appropriate to a removal action, but not both. *Applicable requirements* are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstances found at a CERCLA site. *Relevant and appropriate requirements* are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, RA, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site, and are well-suited to the particular site.

Under CERCLA 121(e), onsite RAs do not need to comply with the administrative requirements of ARARs (environmental laws and regulations, such as permitting). Substantive requirements, however, must be met. Only state standards that are more stringent than federal requirements may be applicable or relevant and appropriate.

The statutes and regulations listed in Table 4-1 contain requirements deemed to be ARARs for the FA RA and describe how the design will comply with those requirements. Table 4-1 is organized by two types of ARARs: action-specific and location-specific. Chemical-specific ARARs were described in the FS and the ROD and were used to develop the cleanup levels for the RAOs described in Section 1.3. Therefore, they are not described in this BODR. Of the ARARs described in the ROD, only those determined to relate to the selected remedy for the FA RA are included in Table 4-1. Federal ARARs that are implemented by the state are not shown in Table 4-1; rather, the state regulation that was also in the ROD is described. Table 4-2 identifies key regulations from the ROD that require full compliance.

## 4.1 Minimizing Public and Environmental Impacts

Environmental and public health and welfare impacts will be minimized through the following methods:

- Site access control
- Development of and adherence to SWPPP
- Transportation and disposal of contaminated and backfill materials
- Compliance with permits/codes

### 4.1.1 Stormwater Management

Subcontractors will be required to implement procedures during construction activities to prevent or reduce pollutants in stormwater discharges, consistent with the Illinois General NPDES permit ILR10 (IEPA 2018). As a matter of coordination, St. Clair County requirements will also be considered. Stormwater pollution prevention features and erosion control features will be described in the SWPPP designed to reduce stormwater pollution potential at the site. The following erosion and sediment control measures will be identified in the plan:

- Silt fence
- Temporary covering of stockpiles, if required by the SWPPP

- Appropriate best management practices at construction site entrance and exit
- Inspections and maintenance procedures

Spill and release accident scenarios could occur and involve rinsates from decontamination activities or contaminated soil. Also, the potential exists for spills of vehicle fuel and hydraulic oils. The SWPPP will address the following activities:

- Preplanning for spill control
- Spill and fire control materials and equipment
- Spill control measures
- Drum, container, and tank handling and moving procedures

The plans will also provide instructions to respond to and mitigate releases on the project site.

### 4.1.2 Transportation and Disposal

The transportation and disposal plan will describe transporting and disposing of contaminated debris and aqueous waste and importing materials from approved borrow sources. The transport vehicles will be tarped or otherwise covered to enclose all loads of contaminated and non-contaminated material during all phases of transportation. The transportation and disposal plan will address the following:

- Identification of all waste streams
- Decontamination procedures
- Waste characterization and profiling
- Waste and container management, storage, labeling, and marking
- Waste transportation practices
- Manifests/haul tickets and other shipping documentation, if required
- Waste disposal, if required
- Spill response and reporting
- Dust abatement
- Traffic control, including any necessary road closure permits or protective measures
- Records and reporting

Table 4-1. Applicable or Relevant and Appropriate Location-Specific and Action-Specific Requirements for the Selected Remedy

*Old American Zinc Superfund Site Facility Area*

| Requirement | Requirement Synopsis | Status |
|---|---|---|
| ***Location-specific ARARs*** | | |
| Endangered Species Act of 1973 (15 United State Code §1531) | Conserve and protect endangered and threatened species and their habitats. | Applicable. Potential presence for protected species on site. USFWS has been consulted regarding the project approach. To mitigate for potential impacts to Indiana bat, clearing of trees with diameter greater than 4 inches will occur outside the period from April 1 through September 30 (see Section 3.4.1.3), to the extent practicable |
| Migratory Bird Treaty Act of 1972 (16 USC 703-712) | Establishes federal responsibility for the protection of the international migratory bird resources. Taking, killing, or possessing migratory birds without authorization is unlawful. | Applicable. Illinois is located within the Mississippi flyway. The design includes procedures to minimize disturbance and avoid destroying active nests. To mitigate for potential impacts to migratory birds, all tree and shrub clearing will occur outside the typical breeding bird season of April 1 through September 10, to the extent practicable, or protective measures will be implemented. |
| Fish and Wildlife Coordination Act<br>16 USC 661- 666 q and 40 CFR 6.302(g) | Requires federal agency consultation with USFWS prior to modification of any stream or water body, to conserve, improve, or prevent loss of non-game wildlife habitat and resources that may be adversely affected by site-related contamination. | Applicable. The USFWS will be consulted regarding measures to prevent, mitigate, or compensate for project-related losses of fish and wildlife resources. |
| Fish and Wildlife Conservation Act<br>16 USC 2901-2912 | Requires federal agencies to conserve and promote conservation of non-game fish and wildlife. | Potentially applicable. Was considered for addressing impacted sediment in ephemeral Rose Creek. |
| National Historic Preservation Act<br>16 USC Section 470 | The Act requires historically significant properties be protected. | Potentially Applicable. Several properties adjacent to the FA are within the NRHP boundary for the Cahokia Mounds site. As a result, the FA may need additional evaluation to determine whether archaeological deposits that contribute to the NRHP listing or additional currently unknown archaeological deposits are present. The State Historic Preservation Office will continue to be consulted related to the effects of the undertaking on listed or eligible properties. |
| Executive Order on Protection of Wetlands<br>E.O. No. 11990<br>40 CFR 6.302(a) and Appendix A | Requires Federal agencies to avoid, to the maximum extent practicable, the adverse effects associated with the destruction or loss of wetlands. | To Be Considered. USFWS National Wetlands Inventory identified mapped wetlands at several areas within the site. Before work commences, a wetland delineation across the entire site will be conducted and a USACE Jurisdictional Determination of whether the wetlands are regulated under the CWA Section 404 will be prepared. The specifications require that work in regulated wetlands complies with substantive requirements of the NWP 38 Cleanup of |

Table 4-1. Applicable or Relevant and Appropriate Location-Specific and Action-Specific Requirements for the Selected Remedy

*Old American Zinc Superfund Site Facility Area*

| Requirement | Requirement Synopsis | Status |
|---|---|---|
| | | Hazardous and Toxic Waste. |
| Section 404 of the Clean Water Act<br>40 CFR Part 230<br>33 CFR Part 330 | Regulates discharge of dredge or fill material into waters of the United States, which include regulated wetlands. The proposed discharge must avoid, to the fullest extent practicable, adverse effects, especially on aquatic ecosystems. | Applicable. USFWS National Wetlands Inventory identified mapped wetlands at several areas within the site. Before work commences, a wetland delineation across the entire site will be conducted and a USACE Jurisdictional Determination of whether the wetlands are regulated under the CWA Section 404 will be prepared. The specifications require that work in regulated wetlands complies with substantive requirements of the NWP 38 Cleanup of Hazardous and Toxic Waste. |
| Executive Order on Floodplain Management (Executive Order No. 11988, 40 *Code of Federal Regulations* Part 6.302(b) and Appendix A | Requires agencies to evaluate the potential effects of actions to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. | To Be Considered. A portion of the Site is located within the 100-year floodplain.<br>The consolidation area and has been located outside of the 100-year floodplain. |
| ***Action-specific ARARs*** | | |
| State Certifications and NPDES<br>(40 Code of Federal Regulations Part 122.26(a)(14)(x)) | Requires the development and implementation of a water pollution prevention plan or a stormwater best management plan. Also outlines monitoring and inspection requirements for a variety of activities. Illinois Environmental Protection Agency implements the NPDES program and the associated stormwater management requirements. | Applicable. The substantive requirements of the Illinois NPDES General Permit for Stormwater Discharge from Construction Site Activities (Illinois General NPDES permit ILR10 (IEPA 2018)) will be followed. |
| Illinois Water Quality Standards<br>(35 IAC, Subtitle C, Chapter 1, Sections 302.208 and 302.210) | Regulations that establish numerical standards and procedures for deriving criteria for toxic substances without numerical standards to restore, maintain, and enhance purity of the water of the state. | Applicable. Water pumped from excavations or dewatering wells that is discharged to surface water without percolating into the ground must meet the standards in 35 IAC Sections 302.208 and 302.210. |
| Illinois Standards for New Solid Waste Landfills (IAC Title 35, Part 807.305(c) Cover) | Cover requirements include “Final Cover – a compacted layer of not less than 2 feet of suitable material.” | Relevant and Appropriate. The contaminated materials will be relocated into a consolidation area, which will have a cover consisting of a 24-inch compacted low-permeability clay barrier, overlain by a 12-inch vegetative soil cover. |

Table 4-1. Applicable or Relevant and Appropriate Location-Specific and Action-Specific Requirements for the Selected Remedy
*Old American Zinc Superfund Site Facility Area*

| Requirement | Requirement Synopsis | Status |
|---|---|---|
| Illinois Solid Waste and Special Waste Handling, Location Standards for New Landfills<br>(IAC Title 35, Part 811.102) | New landfills cannot be located to restrict the flow of a 100-year flood, result in washout, or reduce the temporary water storage capacity of the 100-year floodplain unless specified measures are taken. Facility shall not violate Section 404 of the Clean Water Act, and other requirements | Relevant and Appropriate. The RD has located the consolidation area outside of the 100-year floodplain. |
| IAC Title 35, Part 808 Illinois Special Waste Regulations | Generators are required to classify the waste, manifest the waste, use permitted transporters, and dispose of the waste at a permitted facility | Applicable. Liquids generated by the remedial action, such as decontamination water and wheel wash water, would be considered pollution control waste, if disposed offsite. |
| Fugitive Particulate Matter<br>(IAC Title 35, Part 212, Subpart K) | Establishes requirements for dust control in Sections 212.301, 212.315, and 212.316. | Applicable. The RA may generate fugitive dust; the design addresses methods to minimize and control dust to meet the regulatory standard. |
| Illinois Clean Fill Regulations<br>(IAC Title 35, Part 1100) | State regulations governing clean fill operations | Applicable if imported soil fill is a component of the remedy to fill excavated areas. |
| Illinois Uniform Environmental Covenants Act (765 Illinois Compiled Statutes 122) | The purpose of an environmental covenant is to ensure that land use restrictions and engineering controls designed to control the potential environmental risk of residual contamination will be recorded in the land records and enforced over time, perpetually if necessary, while allowing that real estate to be conveyed from one person to another subject to those controls. | Applicable. The design addresses securing an environmental covenant at locations where cleanup does not achieve unrestricted use standards, to ensure that land use restrictions and engineering controls are recorded in the land records and enforced over time. |
| Noise<br>(IAC Title 35, Subtitle H: Part 900.102-106) | Regulations contain specific requirements that pertain to nuisance noise levels, sound emission standards, and limitations. | Applicable. The design will specify the noise levels set forth in the regulations that will not be exceeded during the RA. |
| Guidance for NPDES Construction Site Stormwater Discharges in the State of Illinois | Guidance related to implementation of the Federal Clean Water Act General Construction Permit program in Illinois. | To Be Considered. Guidance for controlling storm water discharges associated with construction will be considered in developing the SWPPP. |

Table 4-2. Other Key Regulatory Requirements
*Old American Zinc Superfund Site Facility Area*

| Requirement | Requirement Synopsis | Status |
|---|---|---|
| Occupational Safety and Health Act (OSHA)<br>(29 *Code of Federal Regulations* 1910.120) | Specifies minimum requirements to maintain worker health and safety for hazardous waste sites. Includes specific training, monitoring, respiratory protection and personnel protective requirements based on site-specific conditions. | The RD will specify compliance with OSHA. |

SECTION 5

# Construction Schedule

The RA construction is shown on Figure 5-1. It is assumed to start in 2019 and is assumed to occur over the course of two construction seasons. The contractor may expedite the schedule by using multiple crews or by extending the construction season. Depending on the anticipated weather over the course of the winter months, the contractor may propose to work through the winter. This would result in a reduction in the contract price as there will only be one mobilization and demobilization cost.

# Engineer’s Estimate of Construction Cost

The engineer’s estimate of construction cost for the RA, as described in this report, is estimated at $31,375,541 (Class 2 with an accuracy of plus 20 percent to minus 15 percent). Appendix F contains the cost estimate. The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time that the cost estimate was prepared. The final costs of the project will depend on actual labor and material costs, competitive market conditions, actual site conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the cost estimates presented in the final design. Because of these factors, project feasibility and funding needs must be carefully reviewed before specific financial decisions are made or project budgets are established to help ensure project evaluation and adequate funding.

SECTION 7

# Drawings

Drawings are provided in Appendix G. Table 7-1 lists the drawings.

Table 7-1. List of Drawings
*Old American Zinc Superfund Site Facility Area*

| Drawing Number | Drawing Name |
|---|---|
| G-001 | TITLE, LOCATION MAPS, AND INDEX TO DRAWINGS |
| G-002 | LEGEND AND GENERAL NOTES |
| C-001 | MAINTENANCE OF TRAFFIC |
| C-002 | PARCEL DATA SHEET |
| C-101 | FACILITIES AREA EXISTING CONDITIONS - NORTH |
| C-102 | FACILITIES AREA EXISTING CONDITIONS - SOUTH |
| C-103 | SLAG EXCAVATION - NORTH |
| C-104 | SLAG EXCAVATION - SOUTH |
| C-105 | CONSOLIDATION AREA CLAY REMOVAL |
| C-106 | CONSOLIDATION AREA CONSTRUCTION SLAG BACKFILL |
| C-107 | CONSOLIDATION AREA CONSTRUCTION CLAY COVER |
| C-108 | SITE SUBGRADE AND DRAINAGE - NORTH |
| C-109 | SITE SUBGRADE AND DRAINAGE - SOUTH |
| C-201 | SITE SUPPORT INITIAL - NORTH |
| C-202 | SITE SUPPORT INITIAL - SOUTH |
| C-203 | SITE SUPPORT INTERMEDIATE - NORTH |
| C-204 | SITE SUPPORT INTERMEDIATE - SOUTH |
| C-205 | SITE SUPPORT FINAL - NORTH |
| C-206 | SITE SUPPORT FINAL - SOUTH |
| C-301 | CONSOLIDATION AREA SECTIONS |
| C-501 | DETAILS - 01 |
| C-502 | DETAILS - 02 |
| C-503 | DETAILS - 03 |
| C-504 | DETAILS - 04 |

SECTION 8

# Specifications

The following specifications are included in Appendix C:

| | |
|---|---|
| **DIVISION 1—GENERAL REQUIREMENTS** | |
| 01 11 00 | Summary of Work |
| 01 29 00 | Payment Procedures |
| 01 31 13 | Project Coordination |
| 01 31 19 | Project Meetings |
| 01 32 00 | Construction Progress Documentation |
| 01 33 00 | Submittal Procedures |
| 01 45 16.13 | Contractor Quality Control |
| 01 50 00 | Temporary Facilities and Controls |
| 01 57 13 | Pollution Prevention and Temporary Erosion and Sediment Control |
| 01 77 00 | Closeout Procedures |
| **DIVISION 2 – EXISTING CONDITIONS** | |
| 02 24 00 | Delineation of Wetlands and Other Waters of the United States |
| **DIVISION 31—EARTHWORK** | |
| 31 10 00 | Site Clearing |
| 31 23 13 | Subgrade Preparation |
| 31 23 16 | Excavation |
| 31 23 23 | Fill and Backfill |
| **DIVISION 32—EXTERIOR IMPROVEMENTS** | |
| 32 91 13 | Soil Preparation |
| 32 92 00 | Turf and Grasses |

SECTION 9

# Constructability and Biddability Review

Staff from CH2M has reviewed the BODR and specifications with an emphasis on constructability. In addition, this BODR and specifications were reviewed by the project review team, and comments were incorporated, as appropriate. A biddability review will be performed by USACE.

# References

ENTACT. 2009. *Final Remedial Investigation Report, Old American Zinc Plant Site, Fairmont City, Illinois.* March.

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CH2M HILL, Inc. (CH2M). 2017. *Old American Zinc Plant Superfund Site, Fairmont City, St. Clair County, Illinois, Remedial Design*. February.

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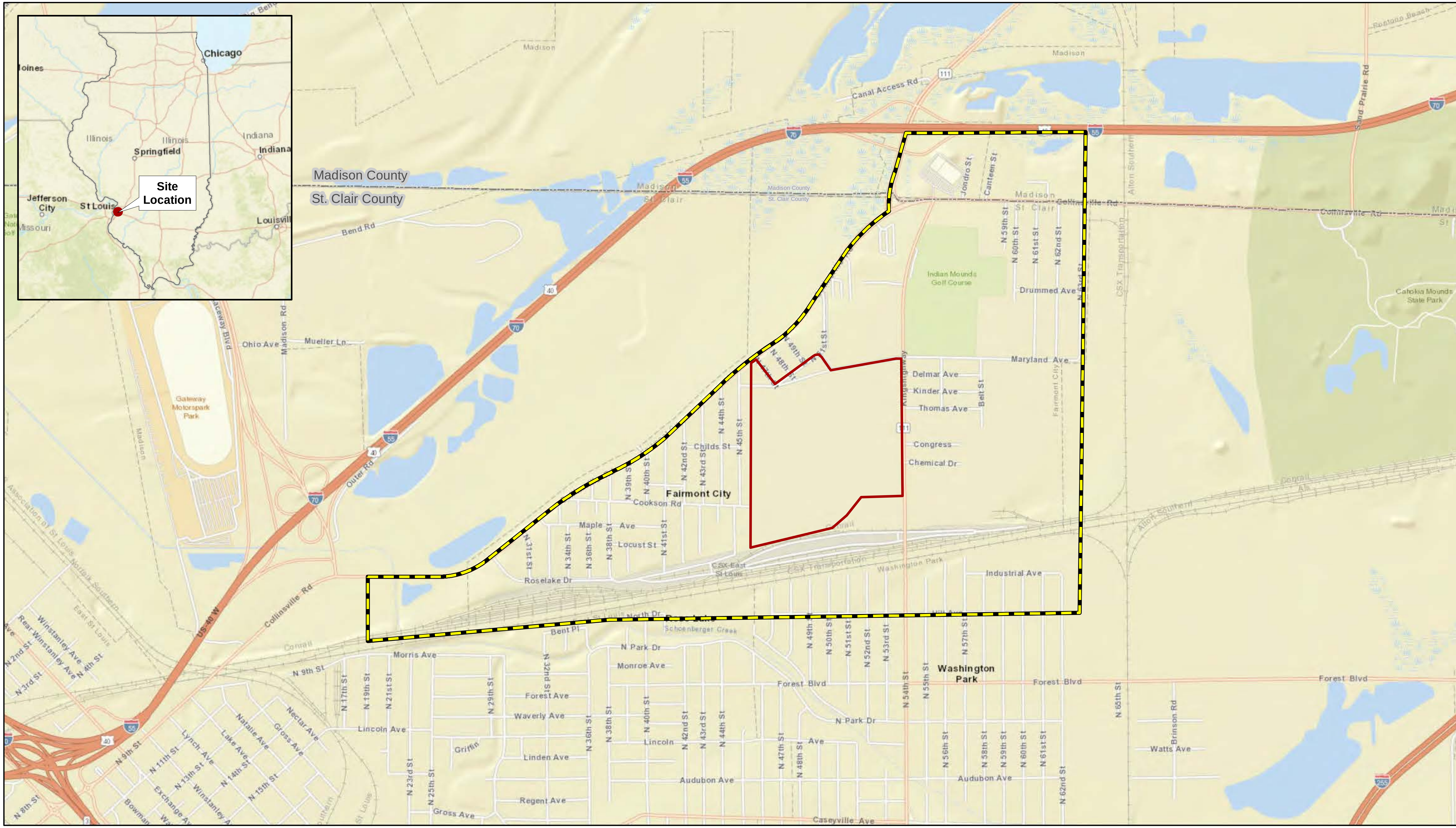
# Figures




Legend

- County Boundary
- Facility Area Boundary
- Surrounding Properties Boundary (Approximate)

N

0 800 1,600

Feet

Notes:

1. Basemap provided by ArcGIS Online World Street Map.

Figure 1-1
Site Location Map
*Old American Zinc Plant Superfund Site*
*Fairmont City, Illinois*

ch2m:

R:\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE1-1_SITE_LOCATION_MAP.MXD AESPEJO 4/25/2018 3:40:10 PM


Legend

- Drainage Ditch
- Facility Area Boundary

**FEMA 100-Year Flood Zones**

- A - No Base Flood Elevations Determined
- AH - Flood Depths of 1 to 3 Feet (Usually Areas of Ponding); Base Flood Elevations Determined

N

0 250 500

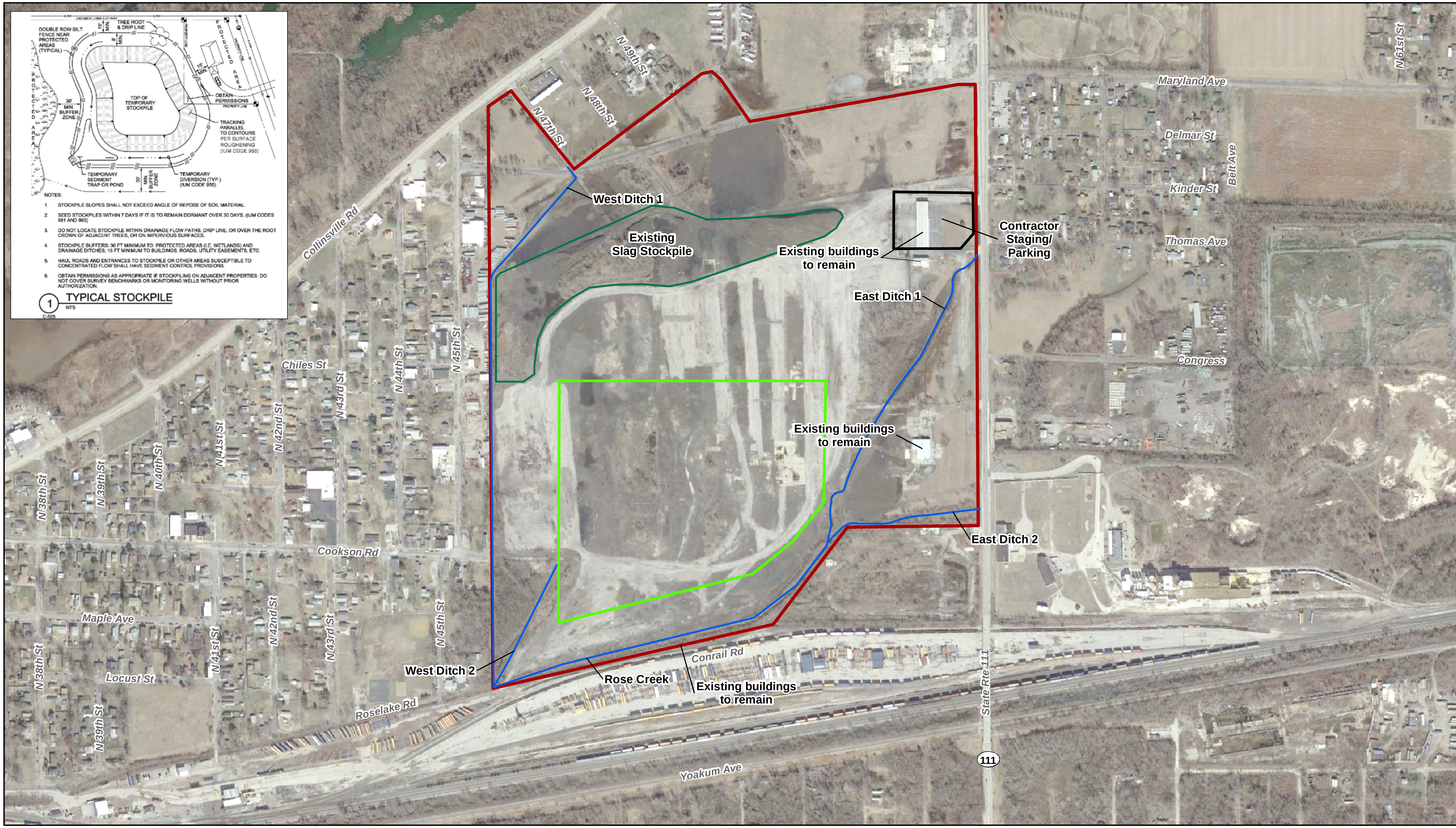
Feet

Note:
Google Earth Imagery Date: April 2, 2016.

Figure 1-2
Floodplain Map
*Old American Zinc Plant Superfund Site*
*Fairmont City, Illinois*

ch2m

R:\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE1-2_FLOODPLAIN_MAP.MXD AESPEJO 5/3/2018 3:30:03 PM




Legend

- Drainage Ditch
- Consolidated Area Location
- Contractor Staging/Parking
- Slag Stockpile
- Facility Area Boundary

N

0 250 500
Feet

Notes:
1. Google Earth Imagery Date: February 24, 2018.
2. No designed stockpiles are being shown. Stockpile location shall follow setbacks as per Illinois Urban Manual and TYPICAL STOCKPILE detail shown in drawing's typical details sheet.

Figure 2-1
*Staging and Stockpile Locations*
*Old American Zinc Plant Superfund Site*
*Fairmont City, Illinois*

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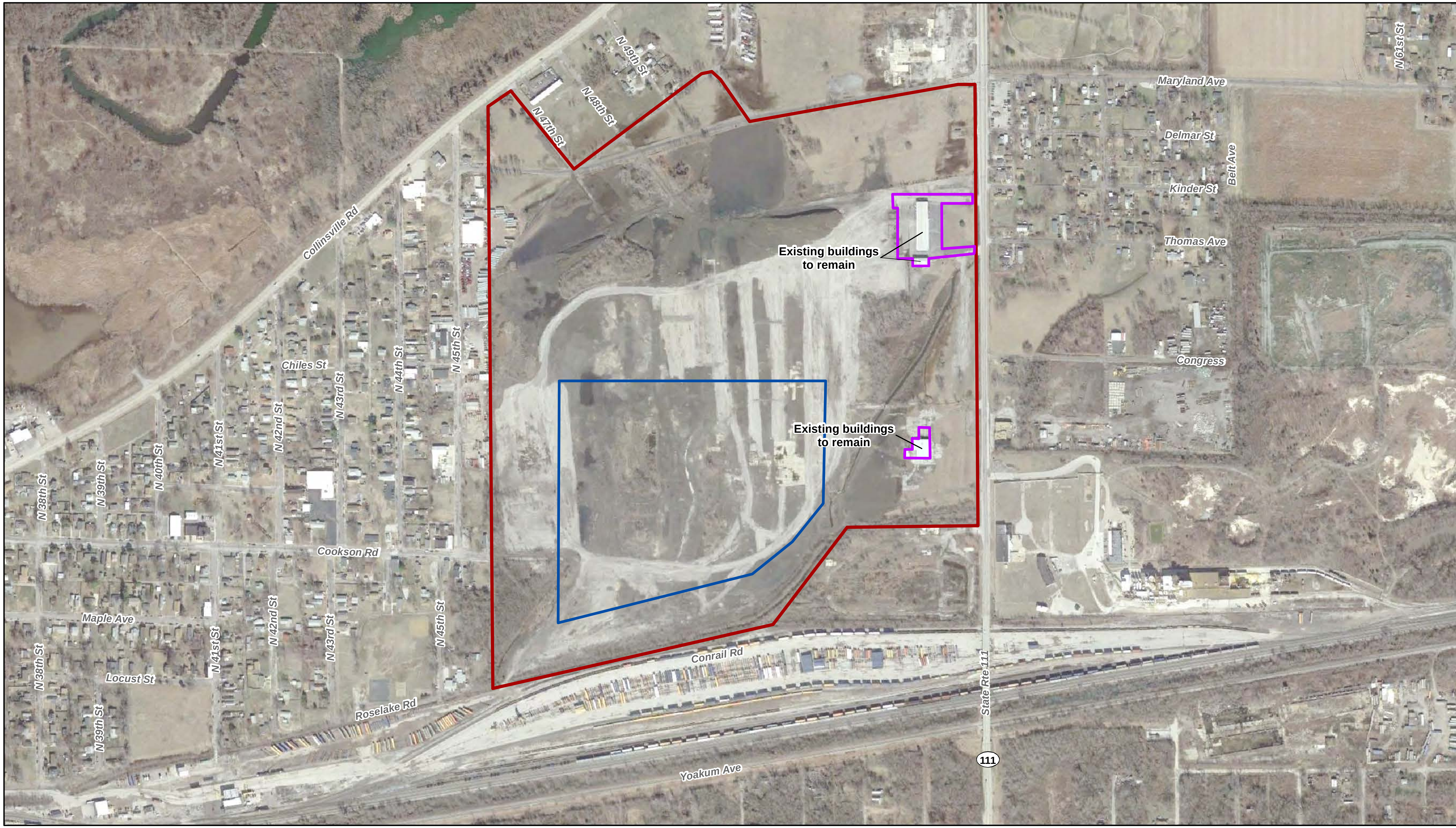
\\BROOKSIDEFILES\GIS_SHARE\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE2-1_STOCKPILE_AND_STAGING_LOCATIONS.MXD JHANSEN1 2/22/2019 12:12:01 PM




N

0 250 500
Feet

Legend
Institutional control-Restricted to non-residential land use control
Institutional control-Engineering control to remain in place
Facility Area Boundary

Notes:
1. Google Earth Imagery Date: February 24, 2018.

Figure 2-2
Institutional Controls
*Old American Zinc Plant Superfund Site*
*Fairmont City, Illinois*

ch2m

\\BROOKSIDEFILES\GIS_SHARE\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE2-2_INSTITUTIONAL_CONTROLS.MXD JHANSEN1 11/14/2018 3:21:21 PM


Legend

0 250 500
Feet

N

- Drainage Ditch
- Consolidated Area Location
- Facility Area Boundary

**FEMA 100-Year Flood Zones**

- A - No Base Flood Elevations Determined
- AH - Flood Depths of 1 to 3 Feet (Usually Areas of Ponding); Base Flood Elevations Determined

Note:
1. Google Earth Imagery Date: February 24, 2018.

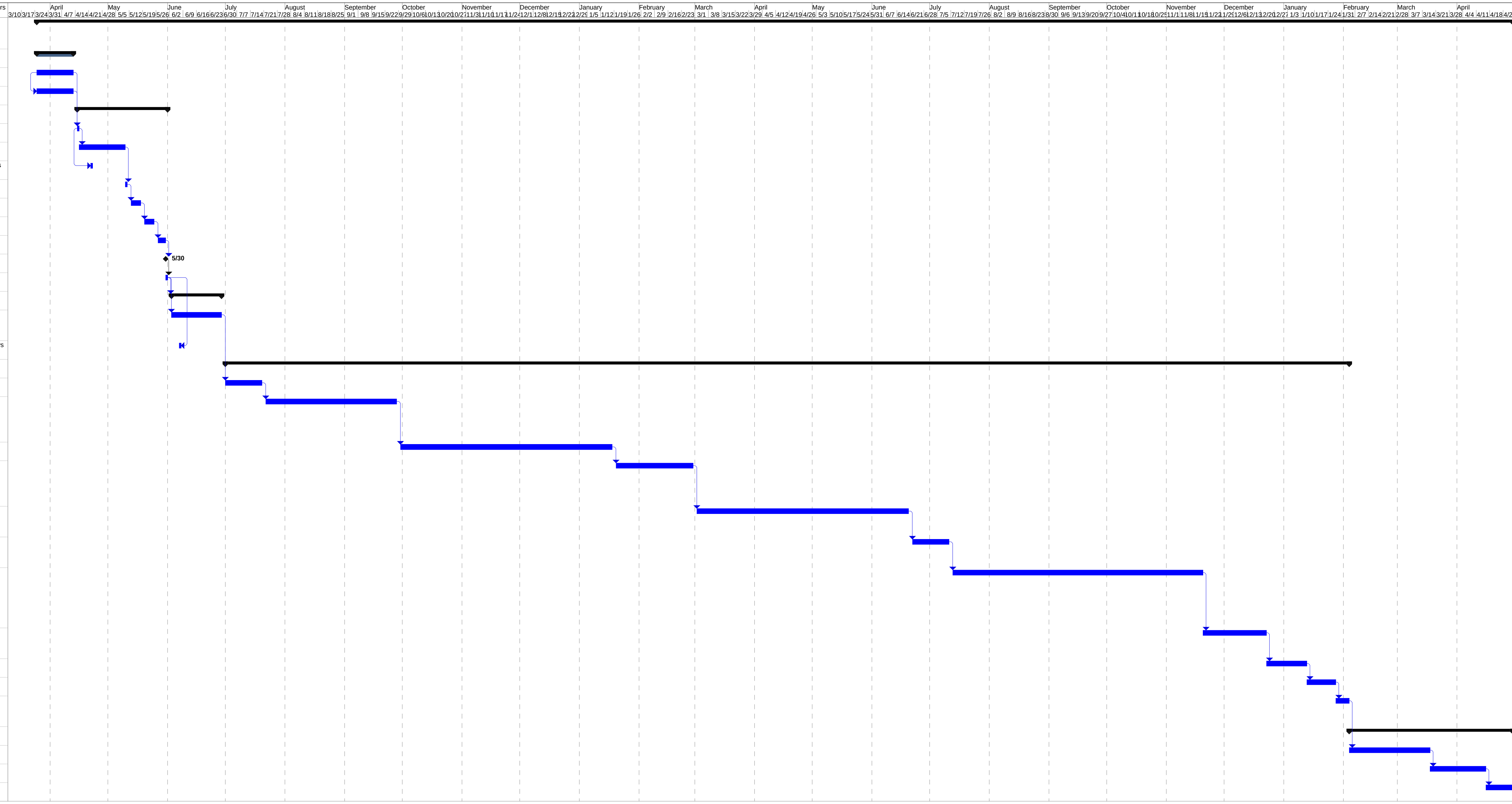
Figure 3-1
Consolidation Area Location
*Old American Zinc Plant Superfund Site*
*Fairmont City, Illinois*

ch2m

\\BROOKSIDEFILES\GIS_SHARE\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE3-1_CONSOLIDATION_AREA_LOCATION.MXD JHANSEN1 2/21/2019 2:42:29 PM

Figure 5-1 Old American Zinc Remedial Action Schedule

| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | **Remedial Action - Old American Zinc Plant Superfund Site, Facility Area** | **549 days** | **Mon 3/25/19** | **Thu 4/29/21** | |
| 2 | **Pre-Bid Activities** | **15 days** | **Mon 3/25/19** | **Fri 4/12/19** | |
| 3 | Prepare Subcontractor SOW | 15 days | Mon 3/25/19 | Fri 4/12/19 | |
| 4 | Prepare Subcontract Bid Documents | 15 days | Mon 3/25/19 | Fri 4/12/19 | 3SS |
| 5 | **Bidding Activities** | **35 days** | **Mon 4/15/19** | **Fri 5/31/19** | |
| 6 | Issue Bid Documents | 1 day | Mon 4/15/19 | Mon 4/15/19 | 3,4 |
| 7 | Bid Process | 18 days | Tue 4/16/19 | Thu 5/9/19 | 6 |
| 8 | Pre-Bid Meeting | 1 day | Mon 4/22/19 | Mon 4/22/19 | 6SS+5 days |
| 9 | Bids Due | 1 day | Fri 5/10/19 | Fri 5/10/19 | 7 |
| 10 | Evaluate Bids/Fact Finding | 5 days | Mon 5/13/19 | Fri 5/17/19 | 9 |
| 11 | Prepare Consent Package for EPA | 5 days | Mon 5/20/19 | Fri 5/24/19 | 10 |
| 12 | EPA Review Consent Package | 4 days | Mon 5/27/19 | Thu 5/30/19 | 11 |
| 13 | Obtain Consent from EPA | 0 days | Thu 5/30/19 | Thu 5/30/19 | 12 |
| 14 | Issue Notice of Award | 1 day | Fri 5/31/19 | Fri 5/31/19 | 13 |
| 15 | **Submittals** | **20 days** | **Mon 6/3/19** | **Fri 6/28/19** | **14** |
| 16 | Subcontractor Develops Premobilization Submittals | 20 days | Mon 6/3/19 | Fri 6/28/19 | 14 |
| 17 | Borrow Source Sampling | 1 day | Fri 6/7/19 | Fri 6/7/19 | 14FF+5 days |
| 18 | **Construction** | **418 days** | **Mon 7/1/19** | **Wed 2/3/21** | |
| 19 | Mobilization and Site Preparations | 15 days | Mon 7/1/19 | Fri 7/19/19 | 16 |
| 20 | Removal of slag from consolidation area and stockpile footprints | 50 days | Mon 7/22/19 | Fri 9/27/19 | 19 |
| 21 | Consolidation Area excavation | 80 days | Mon 9/30/19 | Fri 1/17/20 | 20 |
| 22 | Place Slag from Stockpile in Consolidation Area and Compaction | 30 days | Mon 1/20/20 | Fri 2/28/20 | 21 |
| 23 | Contractor Demobilize for the Season | 80 days | Mon 3/2/20 | Fri 6/19/20 | 22 |
| 24 | Contractor Mobilize and Perform Site Maintenance | 15 days | Mon 6/22/20 | Fri 7/10/20 | 23 |
| 25 | Complete slag placement in Consolidation Area (resume activity from before seasonal break). | 94 days | Mon 7/13/20 | Thu 11/19/20 | 24 |
| 26 | Place Clay Cover on Consolidation Area | 23 days | Fri 11/20/20 | Tue 12/22/20 | 25 |
| 27 | Place Topsoil on Site | 15 days | Wed 12/23/20 | Tue 1/12/21 | 26 |
| 28 | Site Restoration | 11 days | Wed 1/13/21 | Wed 1/27/21 | 27 |
| 29 | Final Punch List and Demobilization | 5 days | Thu 1/28/21 | Wed 2/3/21 | 28 |
| 30 | **Construction Completion Report** | **61 days** | **Thu 2/4/21** | **Thu 4/29/21** | |
| 31 | Prepare Draft Construction Completion Report | 30 days | Thu 2/4/21 | Wed 3/17/21 | 29 |
| 32 | EPA/IEPA Review | 21 days | Thu 3/18/21 | Thu 4/15/21 | 31 |
| 33 | Submit Final Construction Completion Report | 10 days | Fri 4/16/21 | Thu 4/29/21 | 32 |




Old American Zinc Revised Final RA Schedule
Note: Dates are estimated; actual RA start date is TBD.
Date: Fri 2/22/19

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Task | Milestone | Project Summary | External Milestone | Inactive Summary | Duration-only | Manual Summary | Finish-only |
| Split | Summary | External Tasks | Inactive Milestone | Manual Task | Manual Summary Rollup | Start-only | External Tasks |

External Milestone — Deadline — Progress

# Appendix A
# Slope Stability Calculations

**ch2m** 

# Calculation Summary

**Calculation No.:** Geotech_Calc_Packet_ 687729OAZ_001 **Revision No.:** 2

**Project:** 687729OAZ

**Engineering Discipline:** Geotechnical **Date:** 2/22/2019

**Calculation Title & Description:**

Title: Global Stability and Settlement of the Old American Zinc Plant Superfund Site Consolidation Area

Description: This calculation documents the global stability and settlement evaluations for the proposed residuals repository at the Old American Zinc Plant Superfund Site in Fairmont City, St. Clair County, Illinois.

**Revision History:**

| Revision No. | Description | Date | Affected Pages |
|---|---|---|---|
| 0 | Initial Submittal | 04/23/2018 | All |
| 1 | Revised Submittal | 09/18/2018 | All |
| 2 | Revised Submittal | 02/22/2019 | 8, 9 |
| | | | |
| | | | |

**Document Review & Approval:**

**Originator:** Pablo Toloza / Geotechnical Engineer

NAME/POSITION

Toloza Barria, Pablo AAB00417576 Digitally signed by Toloza Barria, Pablo AAB00417576 Date: 2019.02.22 18:42:51 -06'00'

SIGNATURE DATE

**Checked:** Matthew Gavin, P.E. / Geotechnical Engineer

NAME/POSITION

Matthew Gavin Digitally signed by Matthew Gavin Date: 2019.02.25 09:10:01 -06'00'

SIGNATURE DATE

## 1. Subject / Objective / Purpose

This calculation package documents the global stability and settlement evaluations for the proposed residuals repository at the Old American Zinc Plant Superfund Site, located in Fairmont City, St. Clair County, Illinois.

The Old American Zinc Plant Superfund Site is an inactive industrial facility located in Fairmont City, St. Clair County, Illinois. The site includes the 132-acre former zinc smelter facility area (Facility Area) where historical smelting operations and more recent former intermodal trucking operations were conducted, as well as offsite areas (residential, commercial, and vacant properties around the Facility Area; alleyways owned by the Village of Fairmont City that have been filled or resurfaced with slag; and drainageways that receive drainage from the Facility Area) and shallow groundwater within and immediately adjacent to the Facility Area.

A new repository will be built to accommodate over 900 kcy of slag and residuals excavated from the vicinity. Native clay underneath the slag will be excavated to form the bottom of the cell at approximate elevation 410 ft (up to 10 feet below surrounding grade). The slag material will be placed and compacted in lifts. A minimum of 24 inches of compacted soil cover will be placed on top of the slag and residuals, and 12 inches of top soil cover will overlay the compacted clay. The planned final slopes are 4H:1V on the perimeter berms and 3 percent on top of the cover. The maximum cell height will be approximately 30 feet, or about 20 feet above surrounding grade.

## 2. Methodology

Slope stability analyses were performed using SLIDE v. 7.0, a two-dimensional model, to evaluate the factors of safety (FS) against global stability failure. SLIDE is based on the principle of limit equilibrium; that is, it calculates the shear strengths required to maintain equilibrium and then computes a factor of safety (FS) by dividing the available shear strength by the shear strength required to maintain stability. SLIDE generates a large number of potential failure surfaces and calculates the FS for each surface. Rotational (circular) and translational (block and non-circular) surfaces were evaluated using the Spencer method. Drained and undrained static, seismic (pseudostatic), and post-seismic conditions were evaluated.

The cross-section for analysis was selected along the southeast edge of the proposed cell, which represents the maximum cell height and conservatively assumes the perimeter ditch is at the toe of slope.

Limited geotechnical strength data are available for the proposed cell footprint, although general soil types and stratigraphy have been documented by previous soundings and monitoring wells. Therefore, reasonably conservative drained and undrained soil properties were assumed, based on typical values for similar materials as discussed in Section 2.2 and 2.3. Recommendations to verify these strength parameters prior to construction are discussed in Section 4.

Seismic (pseudostatic) analyses were performed using a conservative pseudostatic coefficient ($k_h$) of 50 percent of the peak ground acceleration (PGA) for the 2,475-year return period earthquake (USGS, 2018). Strength reduction factors were used for the pseudostatic and post-seismic analyses, as discussed in Section 2.3.

Settlement of the final cover systems was evaluated using Settle3D, version 4.016. The maximum expected settlement under the consolidation cell and final cover loads was calculated as the sum of immediate and consolidation settlement.

### 2.1 Analysis Criteria

The design criteria for post-closure slope stability factors of safety (FS) for the most critical slopes at the cell unit are shown in Table 1. 35 IAC 811.304 requires that for solid waste facilities, the minimum factor of safety (FS) against slope failure is 1.5 for static conditions. Federal Subtitle D landfill regulations do not specify a minimum seismic FS, so long as slope deformations are tolerable; i.e., 6 to 12 inches are commonly considered acceptable (USEPA, 1995). Using a conservative pseudostatic coefficient of 0.5 (PGA) for the 2,475-year return period earthquake, a pseudostatic FS of 1.0 or greater is expected to correspond to deformations in this range or less. Post-seismic FS is also checked to verify stability even if foundation soil liquefaction were to occur; Illinois-specific post-seismic FS criteria are not published, but 40 CFR 257 requires a minimum post-seismic FS of 1.2.

**Table 1: Design Criteria**

| Case | Minimum FS |
|---|---|
| Static – drained | 1.5 |
| Static – undrained | 1.5 |
| Seismic (pseudostatic) | 1.0 |
| Post-seismic (residual strength) | 1.2 |

### 2.2 Subsurface Conditions

In March of 2009, ENTACT, LLC prepared an Investigation report (ENTACT, 2009), documenting an environmental field investigation performed between 2006 and 2008. 120 geoprobe borings between 4 to 16 feet deep, 7 hand auger borings between 3.5 to 6 feet, 10 wells between 16 to 24 feet deep, and 3 hollow stem auger borings up to 76 feet deep were used to prepare the stratigraphy within the facility.

The subsurface shown in section A-A of the report consist of the following (from top to bottom):

- 4 to 8 feet of slag,
- Approximately 15 feet of Fat Clay, Silty Clay and Clayey silt, from elevation 420 to 405,
- 10 to 20 feet of silt, sand, and mud, from elevations 418 to 387,
- 30 to 35 feet of Fine sand and silt, from elevations 345 to 388, and
- Fine to coarse sand below elevation 360.

Geotechnical strength and consistency data in the report is limited to two borings with SPT blowcounts (SPT N-values) reported for silt and sand below 20 feet bgs. These data indicate the deep silt and sand is medium dense (with SPT N greater than 20), but other soil boring log descriptions indicate the shallower silt and sand could be in a looser condition. Index tests performed on clay samples from test pits indicate that fat clay (USCS classification of CH) are common at the site.

### 2.3 Geotechnical Engineering Properties

The selected geotechnical parameters for slope stability evaluations are summarized in Table 2. Available geotechnical data is included in attachment E. Due to the very limited amount of geotechnical strength and consistency data, conservative strength parameters were selected for the stability and settlement analyses.

The design parameters of the slag/residuals are determined based on available direct shear testing on compacted residuals from another site (Eagle Zinc), which indicated a friction angle greater than 30 degrees. The friction angle used for analysis (23 degrees) is considered conservative.

As discussed in more detail below, testing is recommended prior to cell construction to confirm these parameters.

For seismic (pseudostatic) analyses, an undrained shear strength of 80 percent of the assumed static (peak) shear strength was assigned.

For post-seismic analyses, an undrained shear strength of 65 percent of the static (peak) shear strength was assigned for cohesive soils. For the saturated, potentially loose shallow silts and sands, a post-seismic shear strength ratio (Su/$\sigma$') of 0.1 was conservatively assumed to account for the potential "worst-case" of liquefaction of this layer. For unsaturated or denser granular materials (compacted residuals and medium dense foundation sands), 80 percent of the static (peak) strength was assigned.

Soil parameters used in the global stability analyses are listed in Table 2.

Consolidation parameters for the potentially fat clay (CH) under the cell were selected to evaluate the range in possible settlement. Both normally consolidated (NC) and overconsolidated (OC) conditions were considered for settlement evaluations.

**Table 2: Geotechnical Engineering Strength Parameters by Stratum**

| Stratum | Description | Moist Unit Weight | Assumed Shear Strength Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Static | | | Pseudostatic | | | Post-Seismic Residual | | |
| | | $\gamma_m$ | c' | $\phi$' | $S_u$ | c' | $\phi$' | $S_u$ | c' | $\phi$' | $S_u$ |
| | | (pcf) | (psf) | (deg) | (psf) | (psf) | (deg) | (psf) | (psf) | (deg) | (psf) |
| **Ia** | Fill - Top Soil - Stiff | 130 | 0 | 25 | 1500 | -- | -- | 0.8x Su | -- | -- | 0.65 x Su |
| **Ib** | Fill – Slag and Residuals | 120 | 0 | 23 | (drained) | 0 | 18.8 | (drained) | 0 | 18.8 | (drained) |
| **Ic** | Fill - Clay - Stiff | 128 | 0 | 20-29* | 1000 | -- | -- | 0.8x Su | -- | -- | 0.65 x Su |
| **IIa** | Native - Clay - Stiff | 128 | 50 | 20-29* | 1000 | -- | -- | 0.8x Su | -- | -- | 0.65 x Su |
| **IIb** | Native - Silt - V. Loose | 115 | 0 | 24 | (drained) | 0 | 19.6 | (drained) | -- | -- | Su/$\sigma_v$'=0.1 |
| **IIc** | Native - Sand - M. Dense | 125 | 0 | 29 | (drained) | 0 | 23.9 | (drained) | 0 | 23.9 | (drained) |

(*): A wide range of friction angle for stiff clay (as low as 20 degrees for CH material) was considered

## 2.4 Water Table

Based on monitoring well data, it is anticipated that the water table is about elevation 405. For analysis purposes, water table was considered 415, which is at the bottom of the perimeter ditch.

## 3. Results, Interpretation of Results, and Recommendations

The resulting global stability FS are summarized in Table 3. Full results, including the SLIDE profiles showing critical surfaces, are included in Attachment B. As shown in Table 3, all analyses satisfy the minimum FS criteria based on the soil strength parameters assumed in Table 2.

The estimated total settlement of foundation soils at the cell crest ranges from about 6 inches (for OC clay) to over 3 feet (for NC clay). Over the proposed cover slope length of about 500 feet from crest to perimeter berm, and assuming little settlement at the perimeter berm, this corresponds to about 0.7 percent decrease in the cover slope for NC conditions, some of which would develop during construction (prior to cover construction). If the clay is NC (to be confirmed prior to construction), this potential slope decrease should be accounted for in the constructed cover slope. The OC settlement estimate can likely be accommodated by the cover without modifying the slope. NOTE: If soil liquefaction were to occur during the design earthquake (after cover construction), additional settlement could develop, in which case localized regrading may be required to re-establish the cover slopes.

**Table 3: Factor of safety – Global Stability Analyses**

| Case | Shape of Slip surface | FS |
|---|---|---|
| Static - Drained | Rotational | 2.61-2.39* |
| | Block | 4.19-3.62* |
| | Non-circular | 2.46-2.19* |
| Static - Undrained | Rotational | 4.44 |
| | Block | 5.36 |
| | Non-circular | 4.26 |
| Pseudostatic | Rotational | 1.33 |
| | Block | 1.31 |
| | Non-circular | 1.22 |
| Post-seismic Residual | Rotational | 1.88 |
| | Block | 2.09 |
| | Non-circular | 1.70 |

(*): Factor of safety obtained by assigning a friction angle of 20 degrees to the clayey materials

If cohesive soils with undrained shear strength lower than approximately 1000 psf are encountered below the proposed cell bottom elevation, the Engineer should be contacted to evaluate cell stability and settlement and/or to recommend extents of additional removal and replacement.

Where sand or other cohesionless soils are present at the proposed cell bottom, approximately 2 feet of compacted clay should be placed over the base of the cell prior to placing residuals in those areas.

While the soil parameters in Table 2 are considered reasonably conservative for typical soils, limited geotechnical strength or consistency data is available within the cell footprint. Therefore, verification testing should be performed within the proposed cell footprint to confirm that the soil parameters in Table 2 are representative, and to evaluate the consolidation condition of the foundation clays (NC or OC). This could be done by a grid of CPT soundings around the perimeter of the proposed cell berm, before or after excavating and reaching the base elevation 410 feet, and possibly combined with a few samples collected for geotechnical analysis (index, strength, and consolidation tests). Attachment F includes a proposed CPT sounding location grid.

## 4. References


ENTACT, LLC (2009). Final Remedial Investigation Report. Old American Zinc Plant Site. Fairmont City, Illinois. Revision 2.

Bray, Jonathan D. and Thaleia Travasarou. 2009. Pseudostatic Coefficient for Use in Simplified Seismic Slope Stability Evaluation. J. Geotechnical and Geoenvironmental Eng., ASCE. 1336-1340. September.

Rocscience Inc. (2015) "SLIDE version 7, 2D Limit Equilibrium Slope Stability for Soil & Rock Slopes".

Stark, T.D. and I.A. Contreras, "Fourth Avenue Landslide During 1964 Alaskan Earthquake," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 124, No. 2, February, 1998, pp. 99-109.

USEPA, 1995. RCRA Subtitle D (258) Seismic Design Guidance for Solid Waste Landfill Facilities.

USGS, 2018. Earthquake Hazards Program website. https://earthquake.usgs.gov/designmaps/us/application.php .


## 5. List of Attachments

A. Plan view and Cross Sections

B. Global Stability Analyses

C. Settlement Analyses

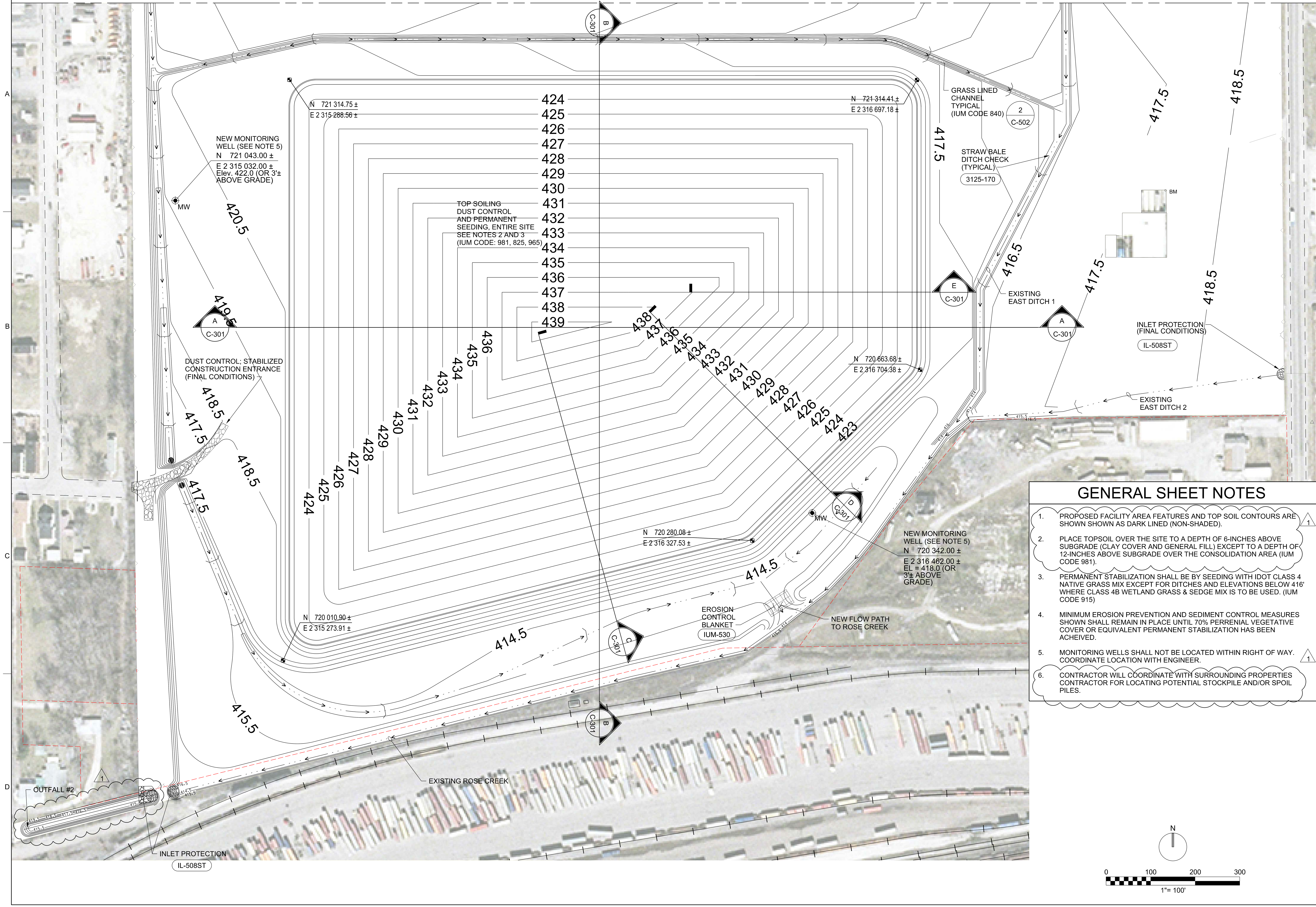
D. Seismicity Data

E. Geotechnical Laboratory Test Results

F. Proposed CPT Sounding Location Grid

# Attachment A

# Plan view and Cross Sections




## GENERAL SHEET NOTES

1. PROPOSED FACILITY AREA FEATURES AND TOP SOIL CONTOURS ARE SHOWN SHOWN AS DARK LINED (NON-SHADED).
2. PLACE TOPSOIL OVER THE SITE TO A DEPTH OF 6-INCHES ABOVE SUBGRADE (CLAY COVER AND GENERAL FILL) EXCEPT TO A DEPTH OF 12-INCHES ABOVE SUBGRADE OVER THE CONSOLIDATION AREA (IUM CODE 981).
3. PERMANENT STABILIZATION SHALL BE BY SEEDING WITH IDOT CLASS 4 NATIVE GRASS MIX EXCEPT FOR DITCHES AND ELEVATIONS BELOW 416' WHERE CLASS 4B WETLAND GRASS & SEDGE MIX IS TO BE USED. (IUM CODE 915)
4. MINIMUM EROSION PREVENTION AND SEDIMENT CONTROL MEASURES SHOWN SHALL REMAIN IN PLACE UNTIL 70% PERRENIAL VEGETATIVE COVER OR EQUIVALENT PERMANENT STABILIZATION HAS BEEN ACHEIVED.
5. MONITORING WELLS SHALL NOT BE LOCATED WITHIN RIGHT OF WAY. COORDINATE LOCATION WITH ENGINEER.
6. CONTRACTOR WILL COORDINATE WITH SURROUNDING PROPERTIES CONTRACTOR FOR LOCATING POTENTIAL STOCKPILE AND/OR SPOIL PILES.

| NO. | DATE | REVISION | BY | APVD |
|---|---|---|---|---|
| 1 | 02/13/19 | REVISED FINAL DESIGN | RQ | MG |

DSGN R QUINNEY | DR R QUINNEY | CHK R VAUGHAN | APVD M GAVIN

US EPA
OLD AMERICAN ZINC PLANT SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

CIVIL

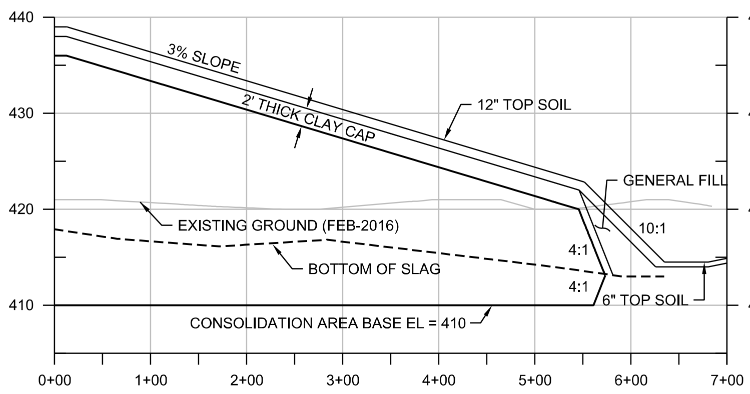
# SITE SUPPORT FINAL - SOUTH

REVISED FINAL DESIGN

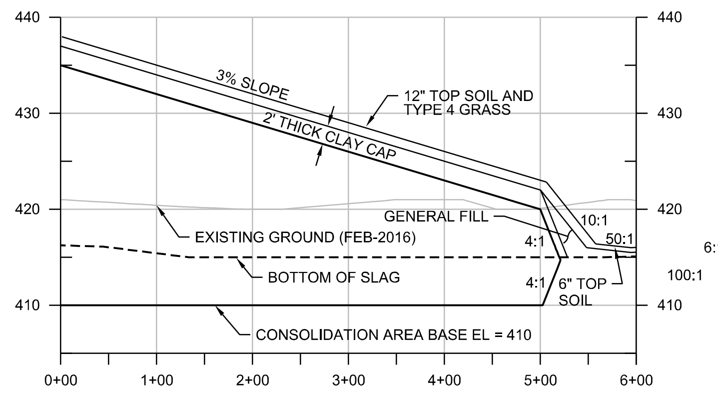


VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

| | |
|---|---|
| DATE | FEB 2019 |
| PROJ | 687729 |
| DWG | C-206 |
| SHEET | 19 of 24 |




SECTION C-C

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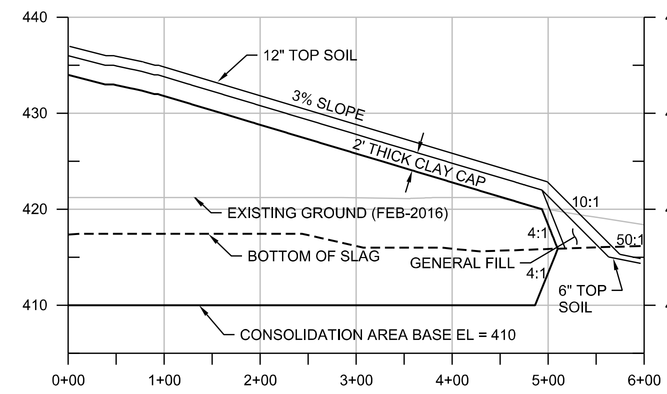
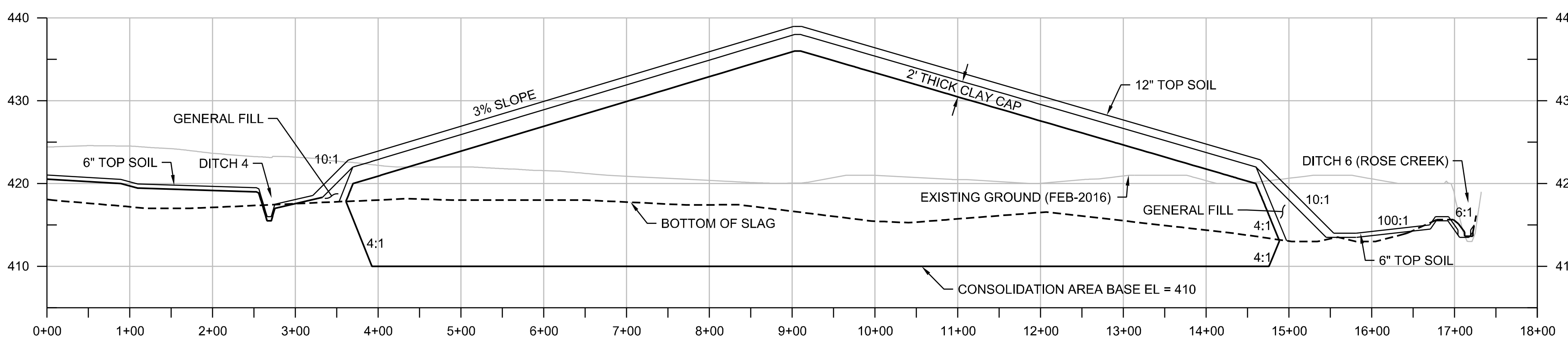
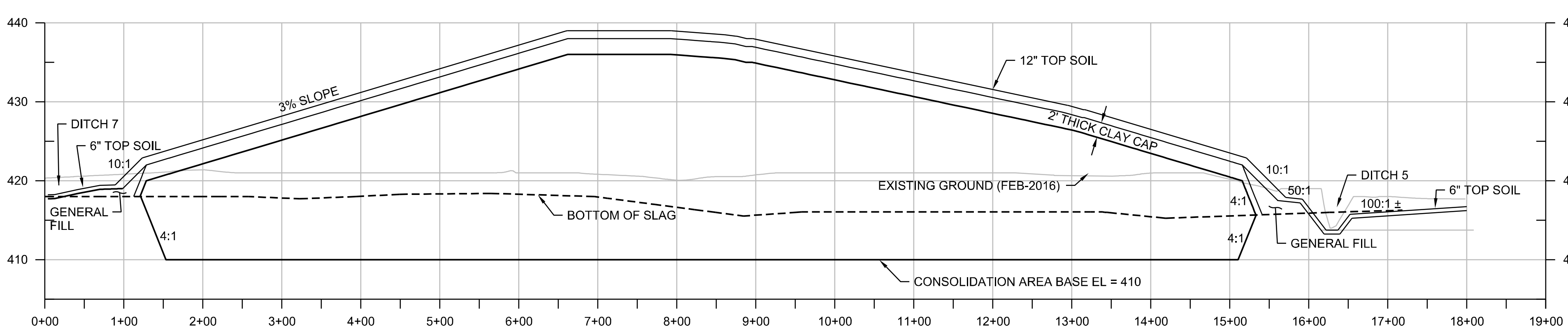


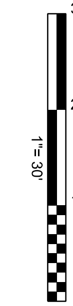

SECTION E-E

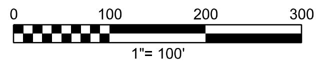



SECTION B-B




SECTION A-A

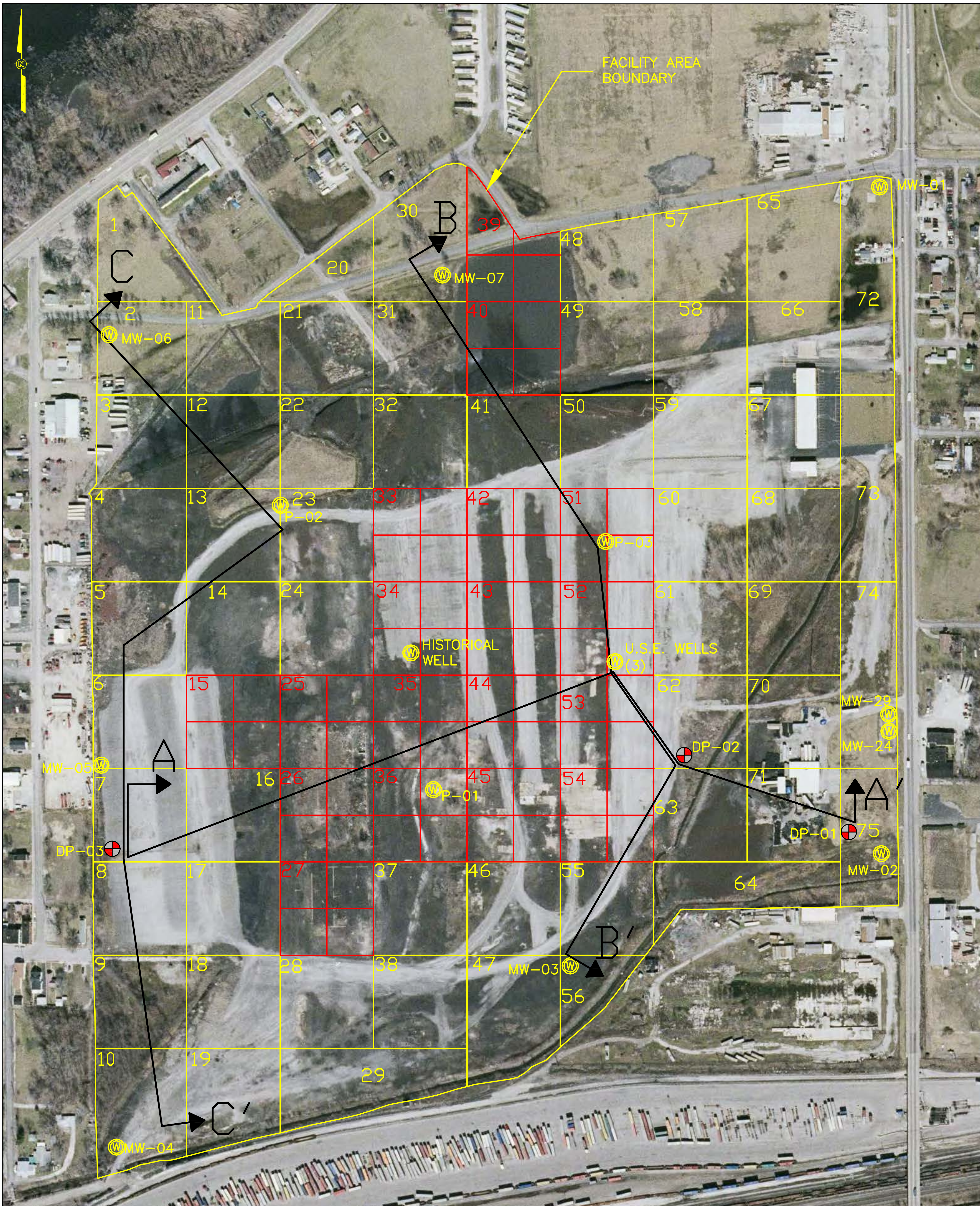



CROSS SECTIONS
PROPOSED TOP OF REPOSITORY GRADES
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN

ch2m

005-C-3001_687729.dgn




LEGEND

- 300' X 300' SAMPLING GRID LAYOUT
- 150' X 150' SAMPLING GRID LAYOUT
- MONITORING WELL LOCATION
- DEEP SOIL BORING LOCATION

SCALE 0' 300' 600'

1. THE INFORMATION PRESENTED HEREIN IS CONFIDENTIAL IN NATURE AND IS NOT TO BE REPRODUCED OR RE-USED WITHOUT THE EXPRESSED WRITTEN PERMISSION OF ENTACT.
2. 2005 ORTHO-RECTIFIED AERIAL PHOTOGRAPH PROVIDED BY SURDEX, CHESTERFIELD, MO.

| REV | DATE | BY | CHK'D | APR'VD | DESCRIPTION |
|---|---|---|---|---|---|
| 1 | 12/15/08 | MMC | PT | PT | ISSUED FOR FINAL RI REPORT |
| 0 | 08/07/08 | MMC | PT | PT | ISSUED FOR DRAFT RI REPORT |

ENTACT
1010 EXECUTIVE COURT, Suite 280
WESTMONT, ILLINOIS 60559
P: 630-986-2900 F: 630-986-0653

DRAWING NAME
DEEP BORING LOCATIONS AND GEOLOGIC CROSS-SECTION LINES A-A', B-B', C-C'

PROJECT NAME & LOCATION
AMERICAN ZINC RIFS
FAIRMONT CITY, ILLINOIS

| DRAWN BY | M. CARLSON | APPROVED BY | P. THOMSON | REVISION | SHEET NO. |
|---|---|---|---|---|---|
| DATE | 01-16-06 | DATE | 01-16-06 | 1 | 1 OF 1 |
| PROJECT NO. | C1727 | FIGURE NO. | 10 | | |

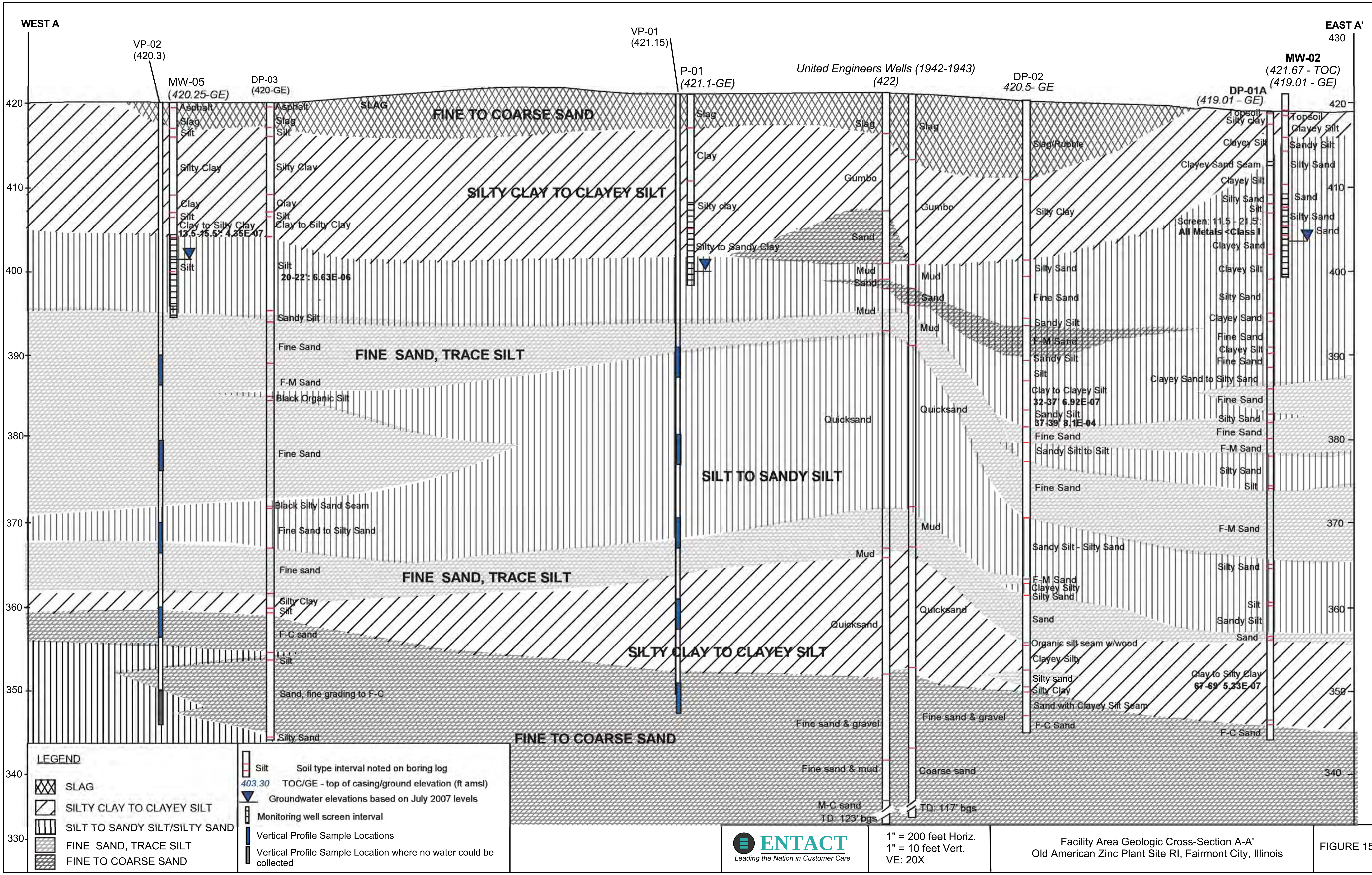
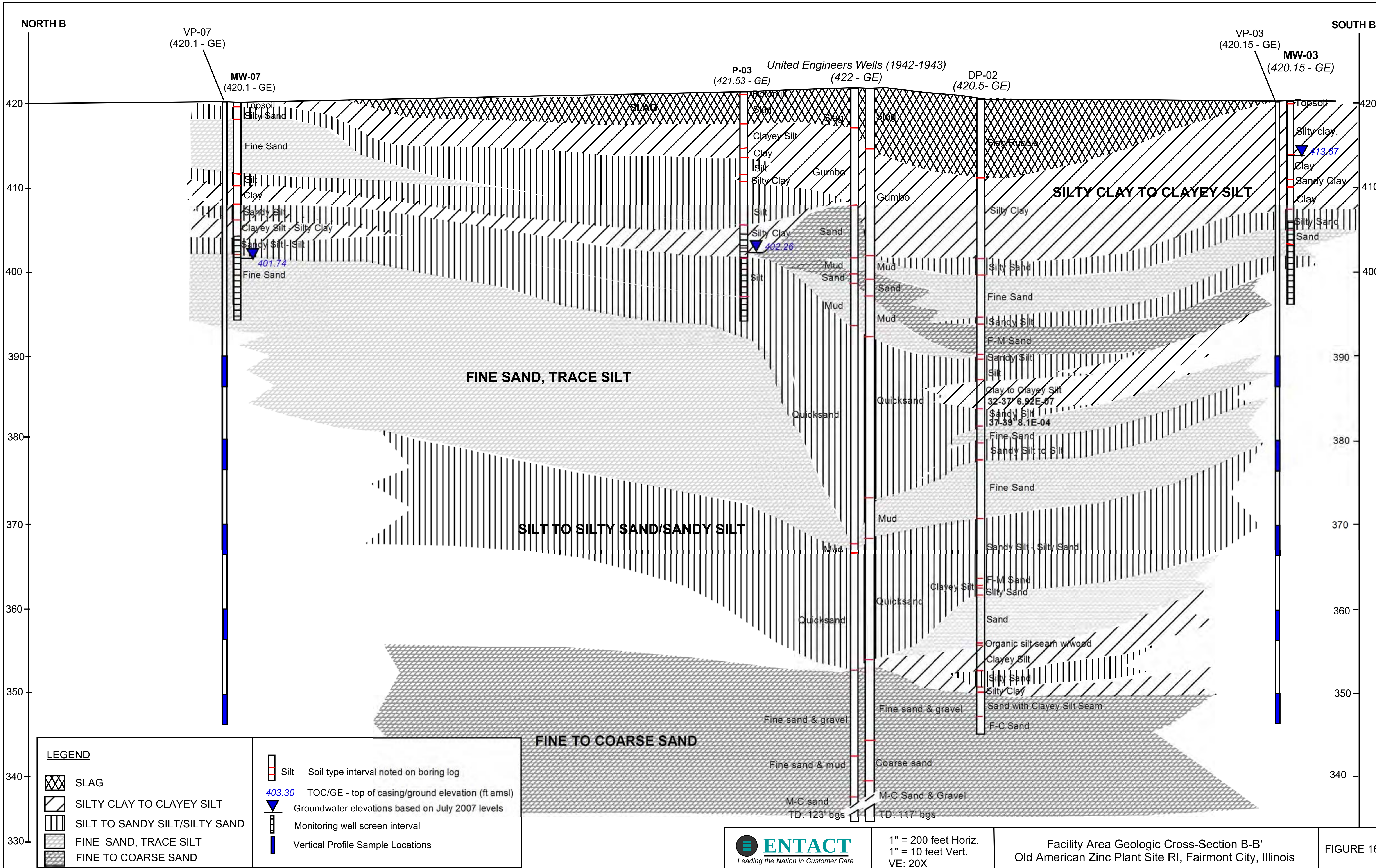


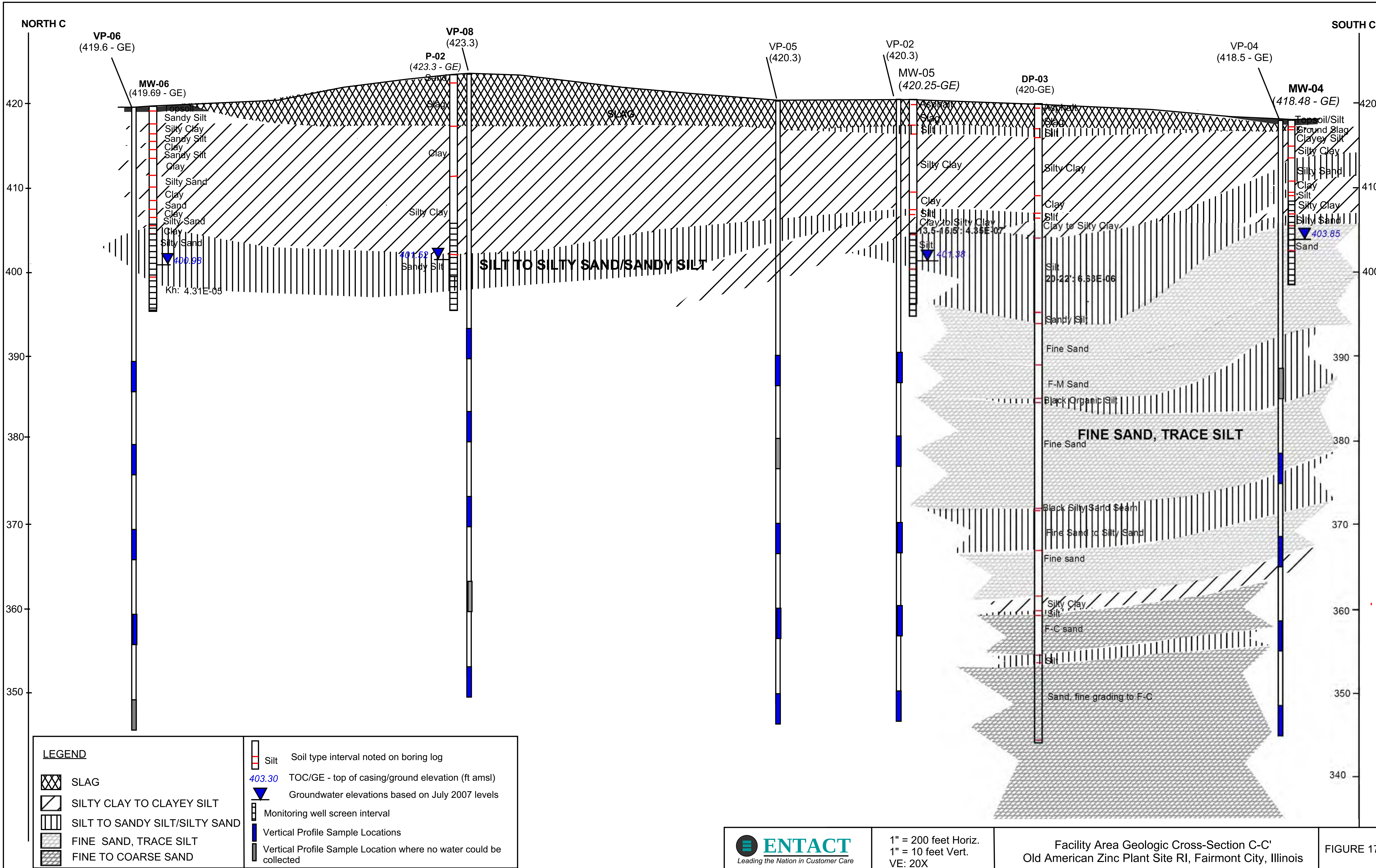

FIGURE 15

Facility Area Geologic Cross-Section A-A'
Old American Zinc Plant Site RI, Fairmont City, Illinois




Facility Area Geologic Cross-Section B-B'
Old American Zinc Plant Site RI, Fairmont City, Illinois

FIGURE 16



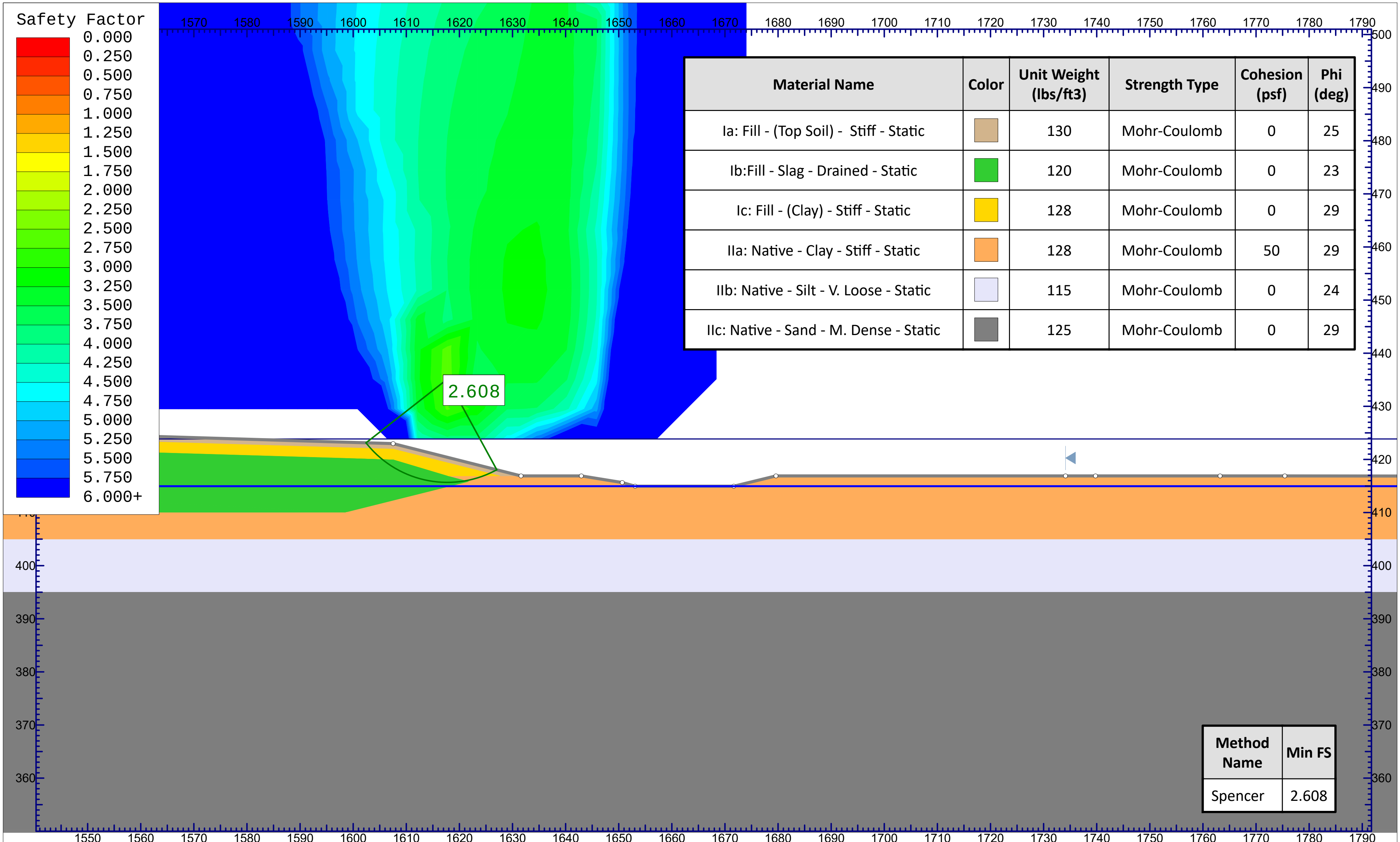

Facility Area Geologic Cross-Section C-C'
Old American Zinc Plant Site RI, Fairmont City, Illinois

FIGURE 17

# Attachment B

# Global Stability Analyses

# Case 1: Static – Drained

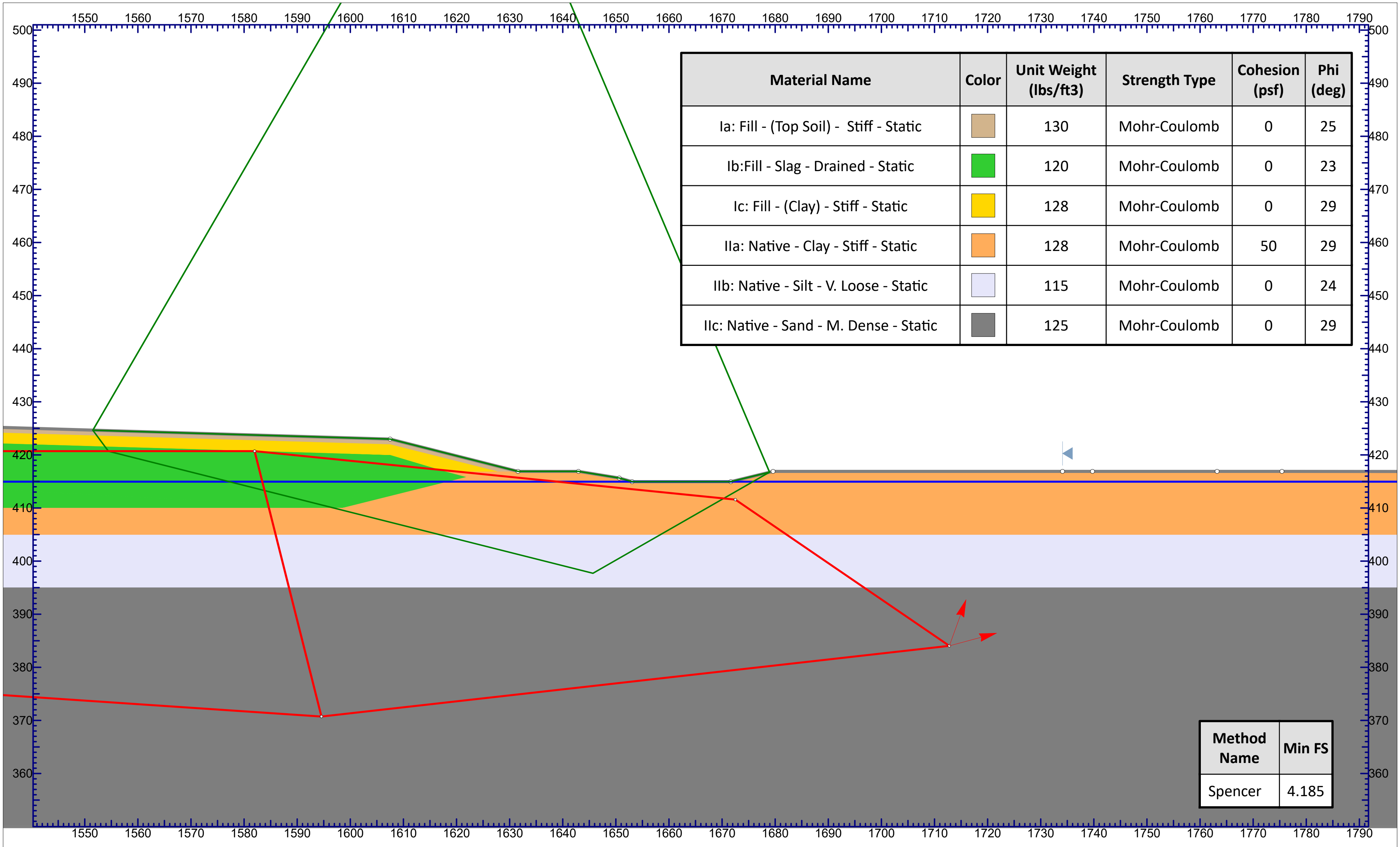



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Static | | 130 | Mohr-Coulomb | 0 | 25 |
| Ib:Fill - Slag - Drained - Static | | 120 | Mohr-Coulomb | 0 | 23 |
| Ic: Fill - (Clay) - Stiff - Static | | 128 | Mohr-Coulomb | 0 | 29 |
| IIa: Native - Clay - Stiff - Static | | 128 | Mohr-Coulomb | 50 | 29 |
| IIb: Native - Silt - V. Loose - Static | | 115 | Mohr-Coulomb | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | Mohr-Coulomb | 0 | 29 |

| Method Name | Min FS |
|---|---|
| Spencer | 2.608 |

SLIDEINTERPRET 7.032

| | | | |
|---|---|---|---|
| *Project* | Old American Zinc | | |
| *Analysis Description* | Section A-Drained-Static - Circular | | |
| *Drawn By* P. Toloza | *Scale* 1:300 | *Company* | CH2M |
| *Date* | 03-27-2018 | *File Name* | OAZ_New Section A.slmd |



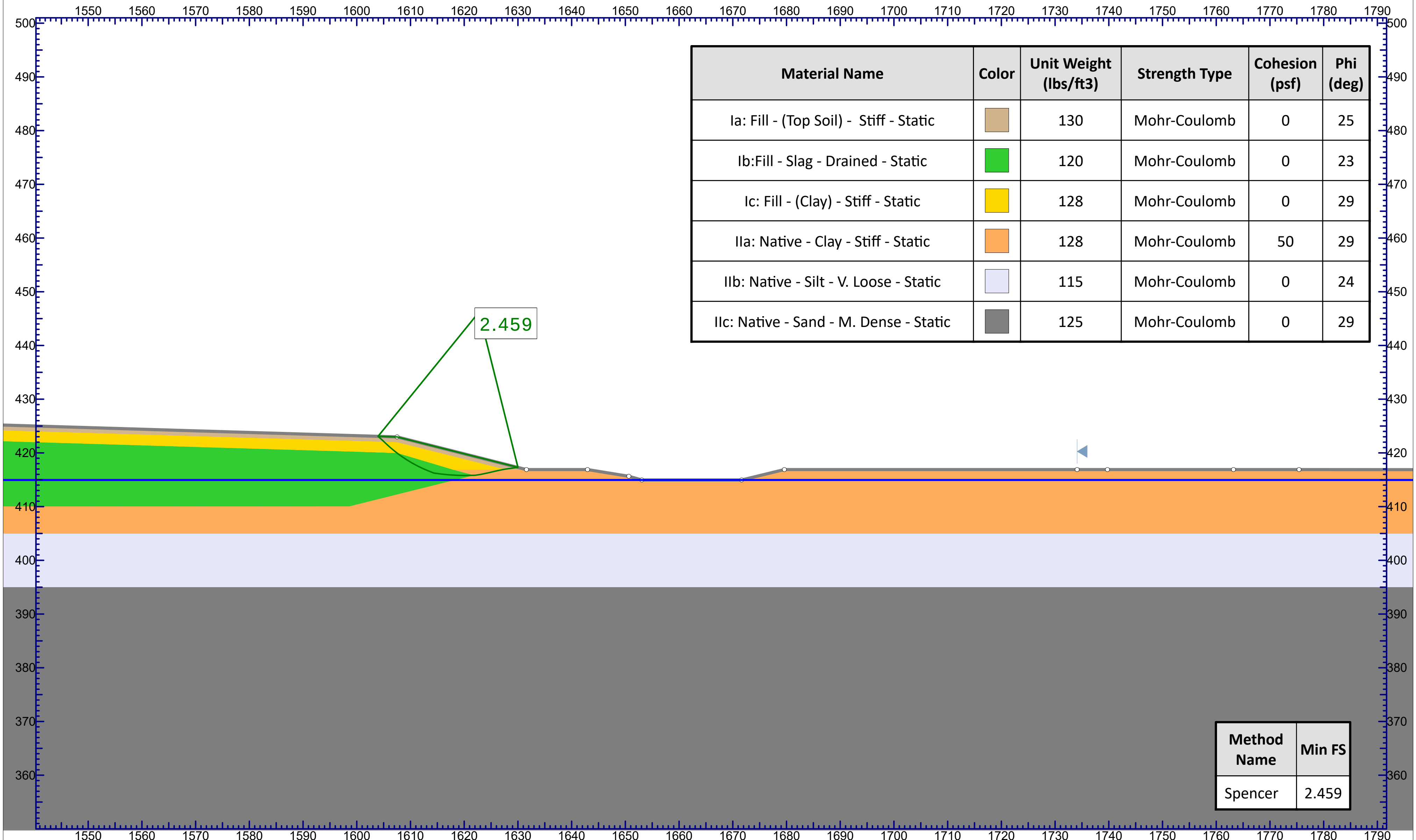

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Static | | 130 | Mohr-Coulomb | 0 | 25 |
| Ib:Fill - Slag - Drained - Static | | 120 | Mohr-Coulomb | 0 | 23 |
| Ic: Fill - (Clay) - Stiff - Static | | 128 | Mohr-Coulomb | 0 | 29 |
| IIa: Native - Clay - Stiff - Static | | 128 | Mohr-Coulomb | 50 | 29 |
| IIb: Native - Silt - V. Loose - Static | | 115 | Mohr-Coulomb | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | Mohr-Coulomb | 0 | 29 |

| Method Name | Min FS |
|---|---|
| Spencer | 4.185 |

ch2m SM

SLIDEINTERPRET 7.032

| | |
|---|---|
| *Project* | Old American Zinc |
| *Analysis Description* | Section A-Drained-Static - Block |
| *Drawn By* | P. Toloza |
| *Scale* | 1:300 |
| *Company* | CH2M |
| *Date* | 03-27-2018 |
| *File Name* | OAZ_New Section A.slmd |

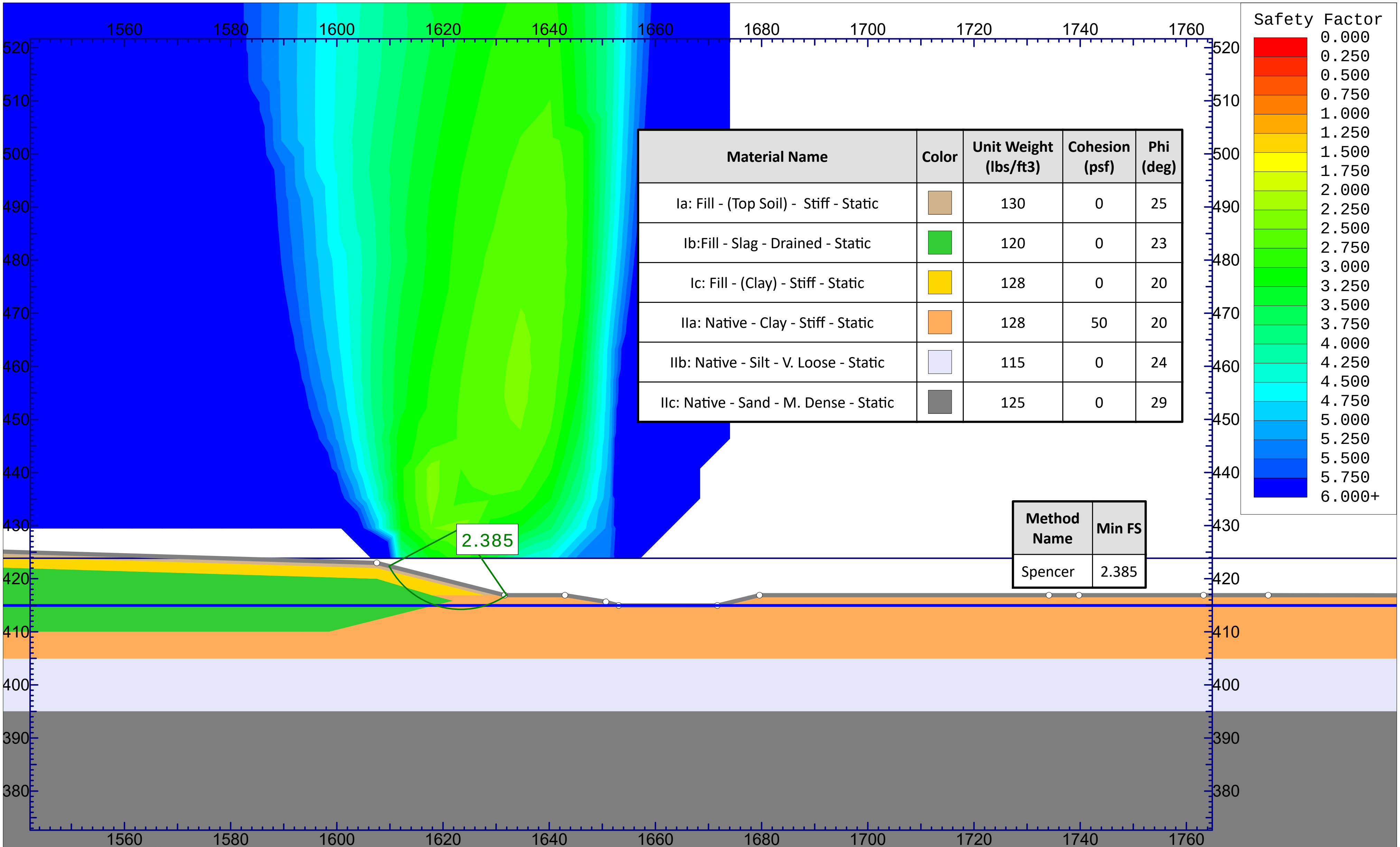



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Static | | 130 | Mohr-Coulomb | 0 | 25 |
| Ib:Fill - Slag - Drained - Static | | 120 | Mohr-Coulomb | 0 | 23 |
| Ic: Fill - (Clay) - Stiff - Static | | 128 | Mohr-Coulomb | 0 | 29 |
| IIa: Native - Clay - Stiff - Static | | 128 | Mohr-Coulomb | 50 | 29 |
| IIb: Native - Silt - V. Loose - Static | | 115 | Mohr-Coulomb | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | Mohr-Coulomb | 0 | 29 |

| Method Name | Min FS |
|---|---|
| Spencer | 2.459 |

SLIDEINTERPRET 7.032

| | |
|---|---|
| *Project* | Old American Zinc |
| *Analysis Description* | Section A-Drained-Static - Non-Circular 2 |
| *Drawn By* | P. Toloza |
| *Scale* | 1:300 |
| *Company* | CH2M |
| *Date* | 03-27-2018 |
| *File Name* | OAZ_New Section A.slmd |

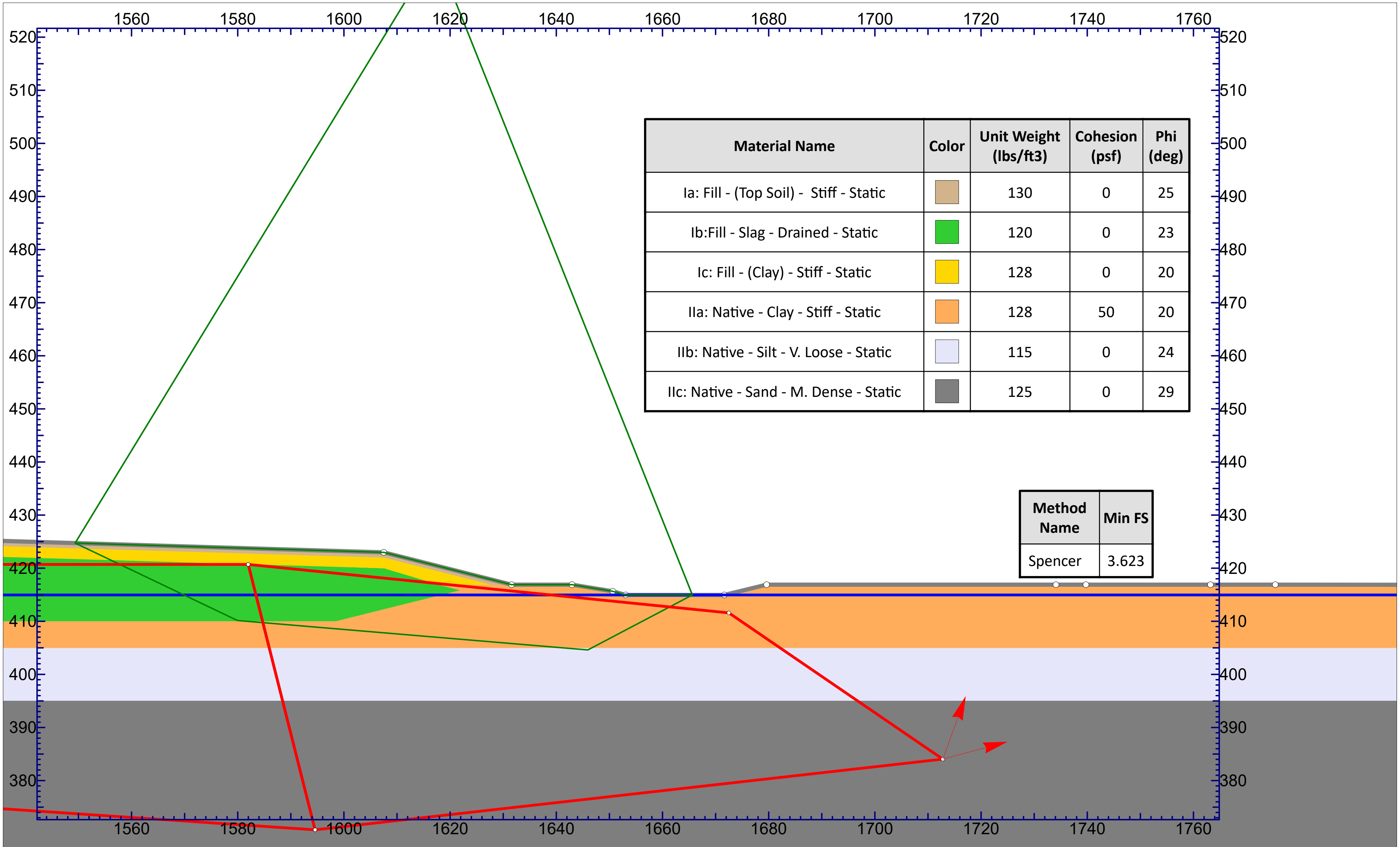



| Material Name | Color | Unit Weight (lbs/ft3) | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Static | | 130 | 0 | 25 |
| Ib:Fill - Slag - Drained - Static | | 120 | 0 | 23 |
| Ic: Fill - (Clay) - Stiff - Static | | 128 | 0 | 20 |
| IIa: Native - Clay - Stiff - Static | | 128 | 50 | 20 |
| IIb: Native - Silt - V. Loose - Static | | 115 | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | 0 | 29 |

| Method Name | Min FS |
|---|---|
| Spencer | 2.385 |

| | | | |
|---|---|---|---|
| *Project* | Old American Zinc | | |
| *Analysis Description* | Section A - Drained-Static - Circular - For drained static check of clay with phi'=20 deg | | |
| *Drawn By* P. Toloza | *Scale* 1:300 | *Company* | CH2M |
| *Date* 07-03-2018 | | *File Name* | OAZ_New Section A_rev.slmd |

SLIDEINTERPRET 7.036



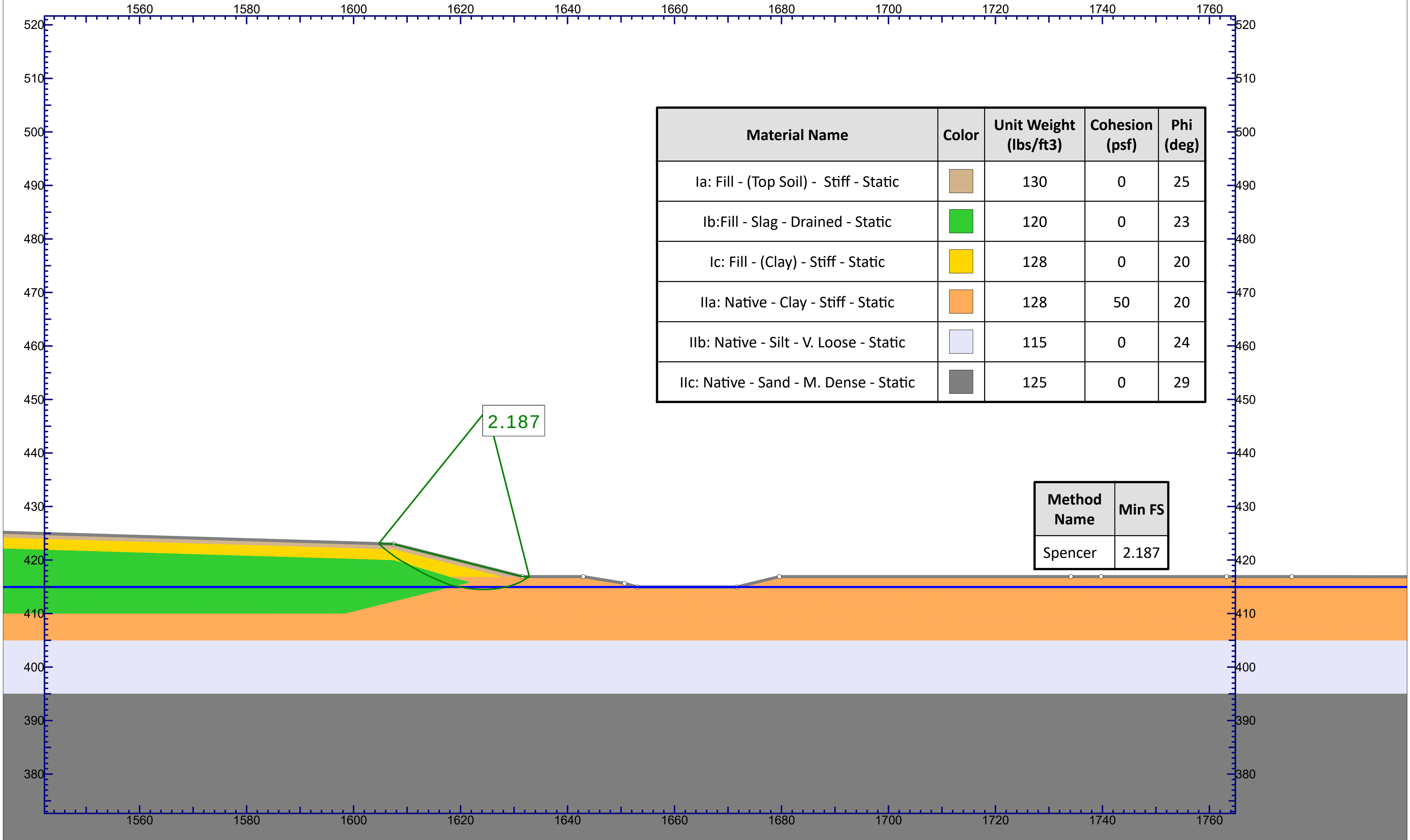

| Material Name | Color | Unit Weight (lbs/ft3) | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Static | | 130 | 0 | 25 |
| Ib:Fill - Slag - Drained - Static | | 120 | 0 | 23 |
| Ic: Fill - (Clay) - Stiff - Static | | 128 | 0 | 20 |
| IIa: Native - Clay - Stiff - Static | | 128 | 50 | 20 |
| IIb: Native - Silt - V. Loose - Static | | 115 | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | 0 | 29 |

| Method Name | Min FS |
|---|---|
| Spencer | 3.623 |

ch2m SM

SLIDEINTERPRET 7.036

| | | | |
|---|---|---|---|
| *Project* | Old American Zinc | | |
| *Analysis Description* | Section A - Drained-Static - Block - For drained static check of clay with phi'=20 deg | | |
| *Drawn By* P. Toloza | *Scale* 1:300 | *Company* | CH2M |
| *Date* | 07-03-2018 | *File Name* | OAZ_New Section A_rev.slmd |




| Material Name | Color | Unit Weight (lbs/ft3) | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Static | | 130 | 0 | 25 |
| Ib:Fill - Slag - Drained - Static | | 120 | 0 | 23 |
| Ic: Fill - (Clay) - Stiff - Static | | 128 | 0 | 20 |
| IIa: Native - Clay - Stiff - Static | | 128 | 50 | 20 |
| IIb: Native - Silt - V. Loose - Static | | 115 | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | 0 | 29 |

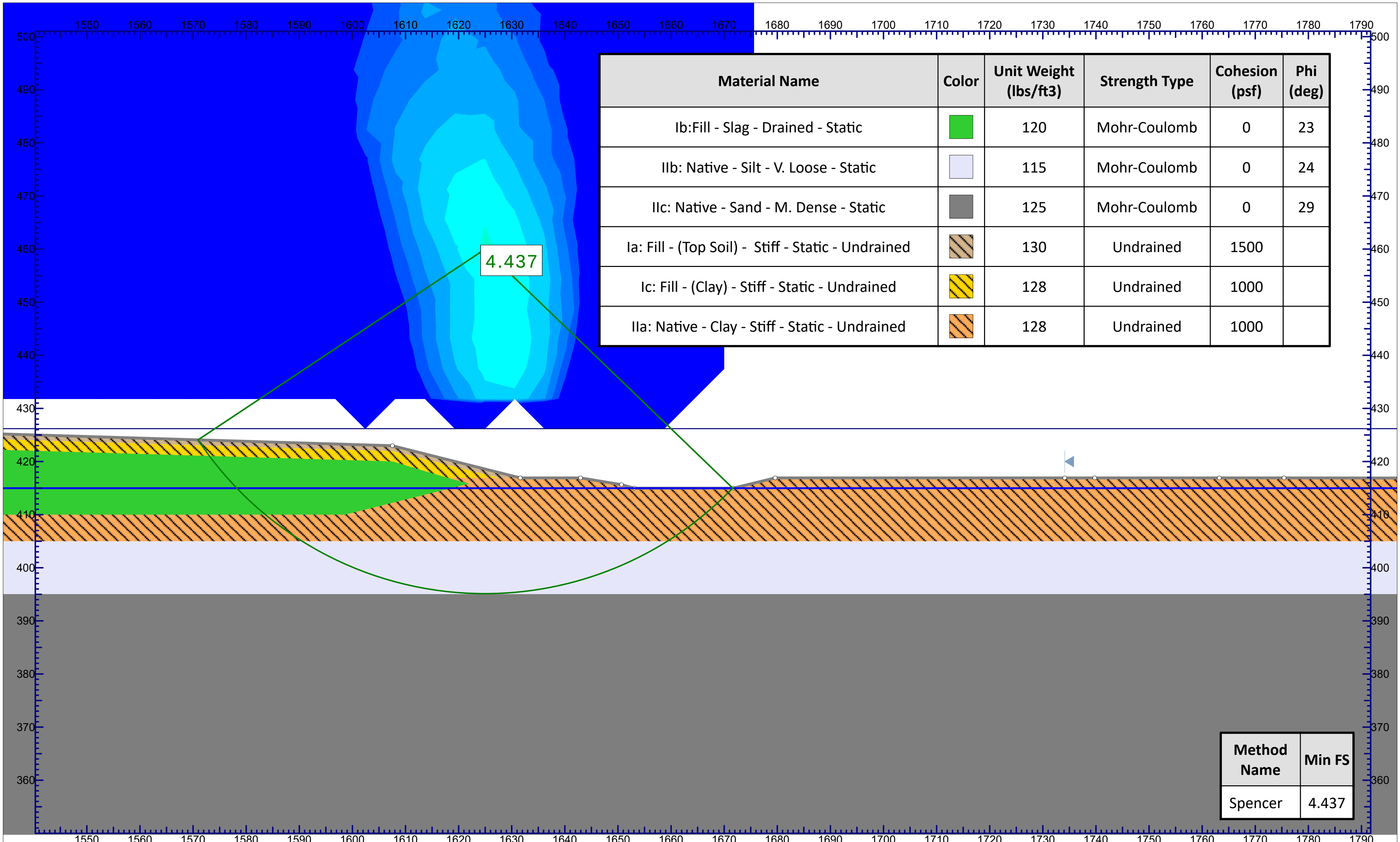
| Method Name | Min FS |
|---|---|
| Spencer | 2.187 |

ch2m SM

SLIDEINTERPRET 7.036

| | |
|---|---|
| *Project* | Old American Zinc |
| *Analysis Description* | Section A - Drained-Static - Non-Circular 2 - For drained static check of clay with phi'=20 deg |
| *Drawn By* | P. Toloza |
| *Scale* | 1:300 |
| *Company* | CH2M |
| *Date* | 07-03-2018 |
| *File Name* | OAZ_New Section A_rev.slmd |

# Case 2: Static – Undrained

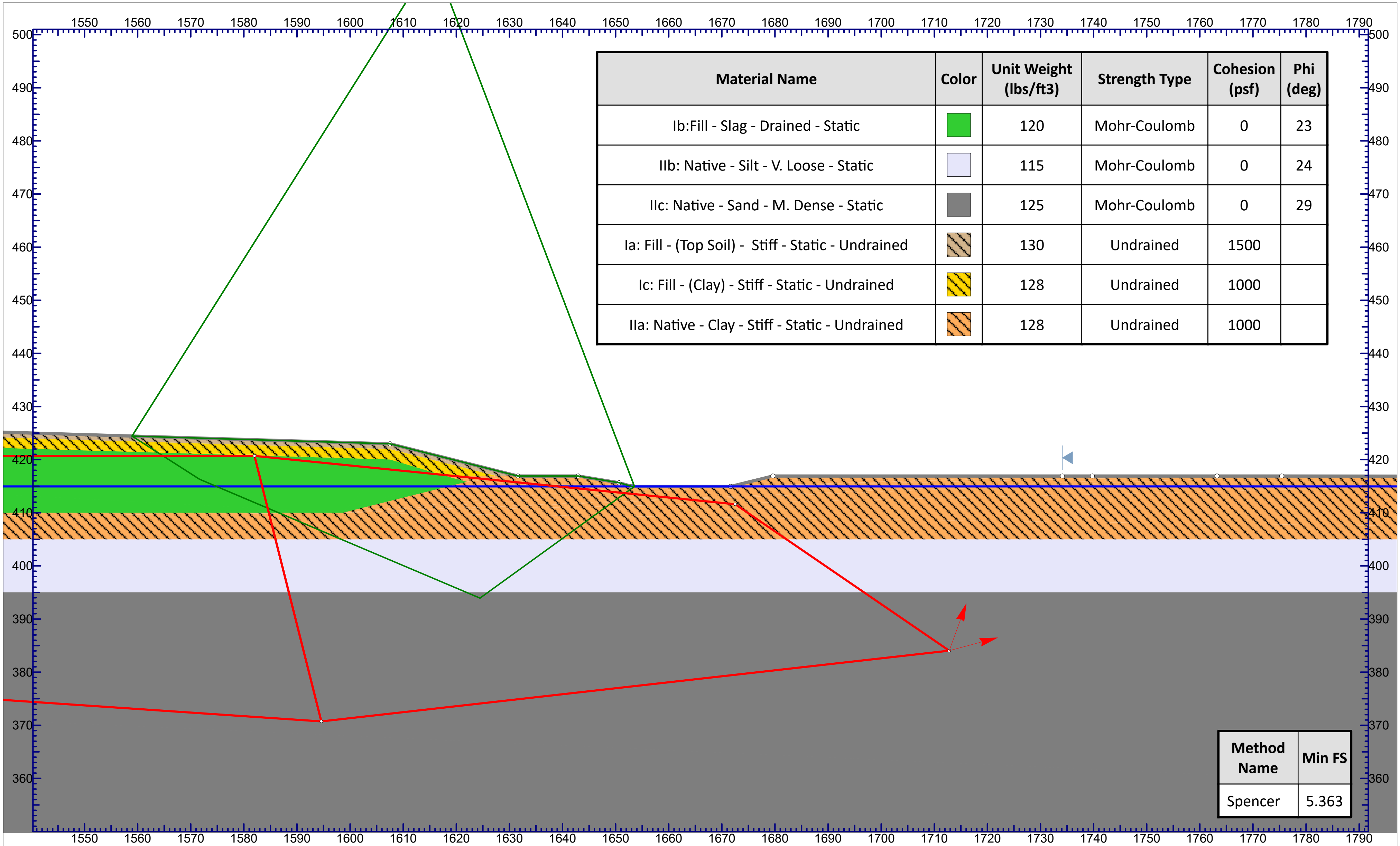



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ib:Fill - Slag - Drained - Static | | 120 | Mohr-Coulomb | 0 | 23 |
| IIb: Native - Silt - V. Loose - Static | | 115 | Mohr-Coulomb | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | Mohr-Coulomb | 0 | 29 |
| Ia: Fill - (Top Soil) - Stiff - Static - Undrained | | 130 | Undrained | 1500 | |
| Ic: Fill - (Clay) - Stiff - Static - Undrained | | 128 | Undrained | 1000 | |
| IIa: Native - Clay - Stiff - Static - Undrained | | 128 | Undrained | 1000 | |

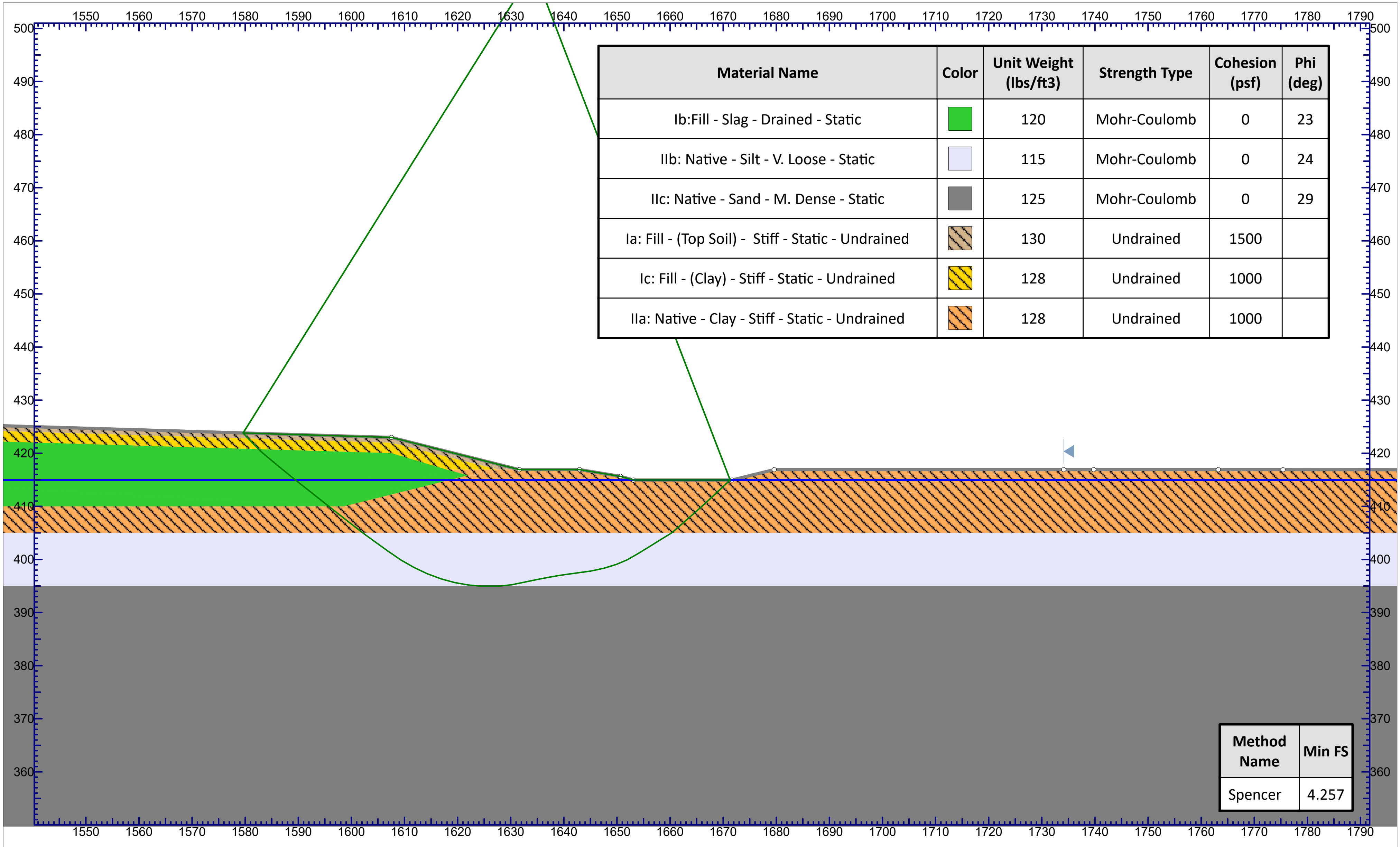
| Method Name | Min FS |
|---|---|
| Spencer | 4.437 |

| | | | |
|---|---|---|---|
| *Project* | Old American Zinc | | |
| *Analysis Description* | Section A-Undrained-Static - Circular | | |
| *Drawn By* | P. Toloza | *Scale* 1:300 | *Company* CH2M |
| *Date* | 03-27-2018 | *File Name* | OAZ_New Section A.slmd |

SLIDEINTERPRET 7.034




| | | | |
|---|---|---|---|
| ch2m SM | Project | Old American Zinc | |
| | Analysis Description | Section A-Undrained-Static - Block | |
| | Drawn By: P. Toloza | Scale: 1:300 | Company: CH2M |
| SLIDEINTERPRET 7.034 | Date: 03-27-2018 | File Name: OAZ_New Section A.slmd | |



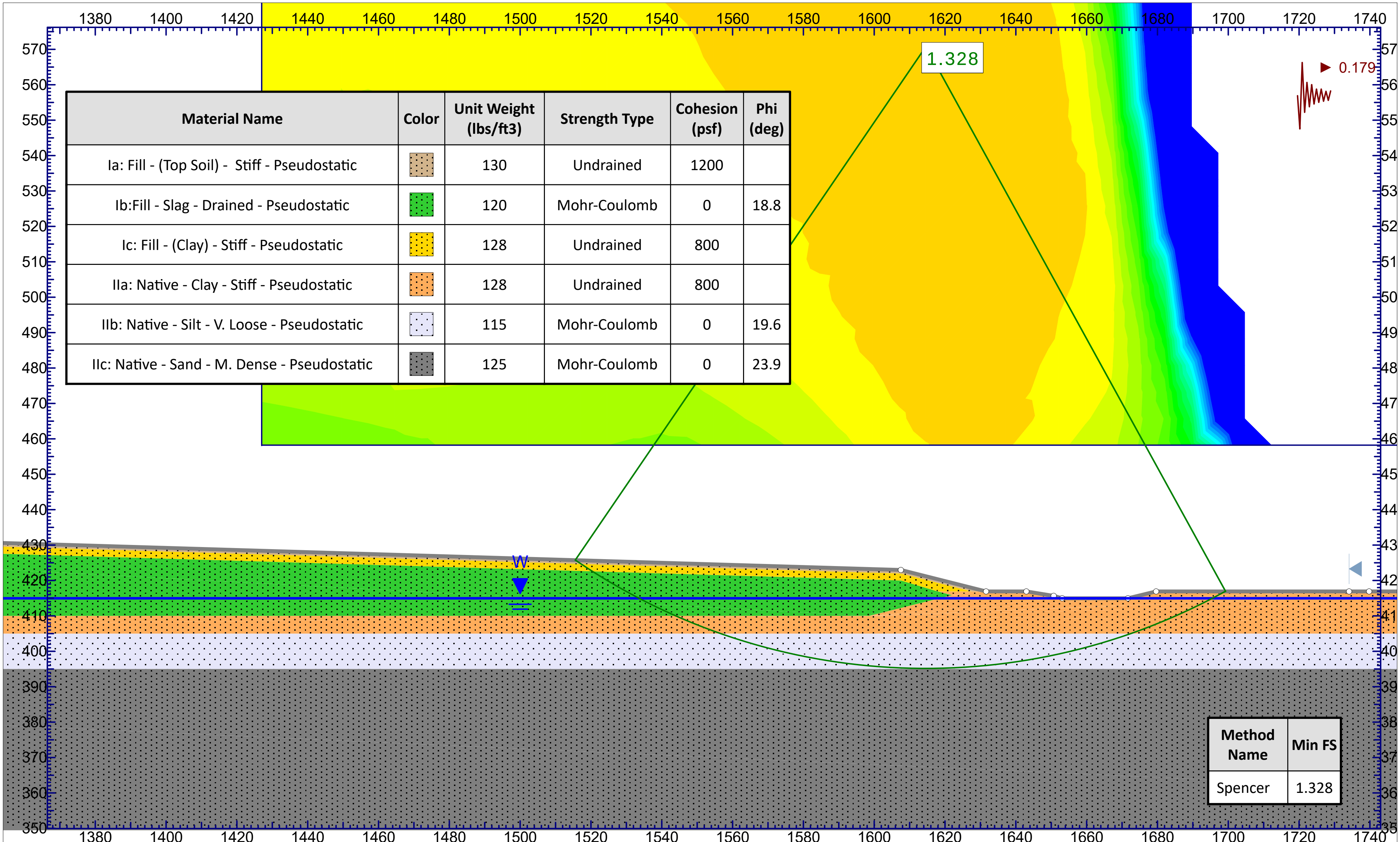

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ib:Fill - Slag - Drained - Static | | 120 | Mohr-Coulomb | 0 | 23 |
| IIb: Native - Silt - V. Loose - Static | | 115 | Mohr-Coulomb | 0 | 24 |
| IIc: Native - Sand - M. Dense - Static | | 125 | Mohr-Coulomb | 0 | 29 |
| Ia: Fill - (Top Soil) - Stiff - Static - Undrained | | 130 | Undrained | 1500 | |
| Ic: Fill - (Clay) - Stiff - Static - Undrained | | 128 | Undrained | 1000 | |
| IIa: Native - Clay - Stiff - Static - Undrained | | 128 | Undrained | 1000 | |

| Method Name | Min FS |
|---|---|
| Spencer | 4.257 |

| | |
|---|---|
| *Project* | Old American Zinc |
| *Analysis Description* | Section A-Undrained-Static - Non-Circular 2 |
| *Drawn By* | P. Toloza |
| *Scale* | 1:300 |
| *Company* | CH2M |
| *Date* | 03-27-2018 |
| *File Name* | OAZ_New Section A.slmd |

SLIDEINTERPRET 7.034

# Case 3: Pseudostatic

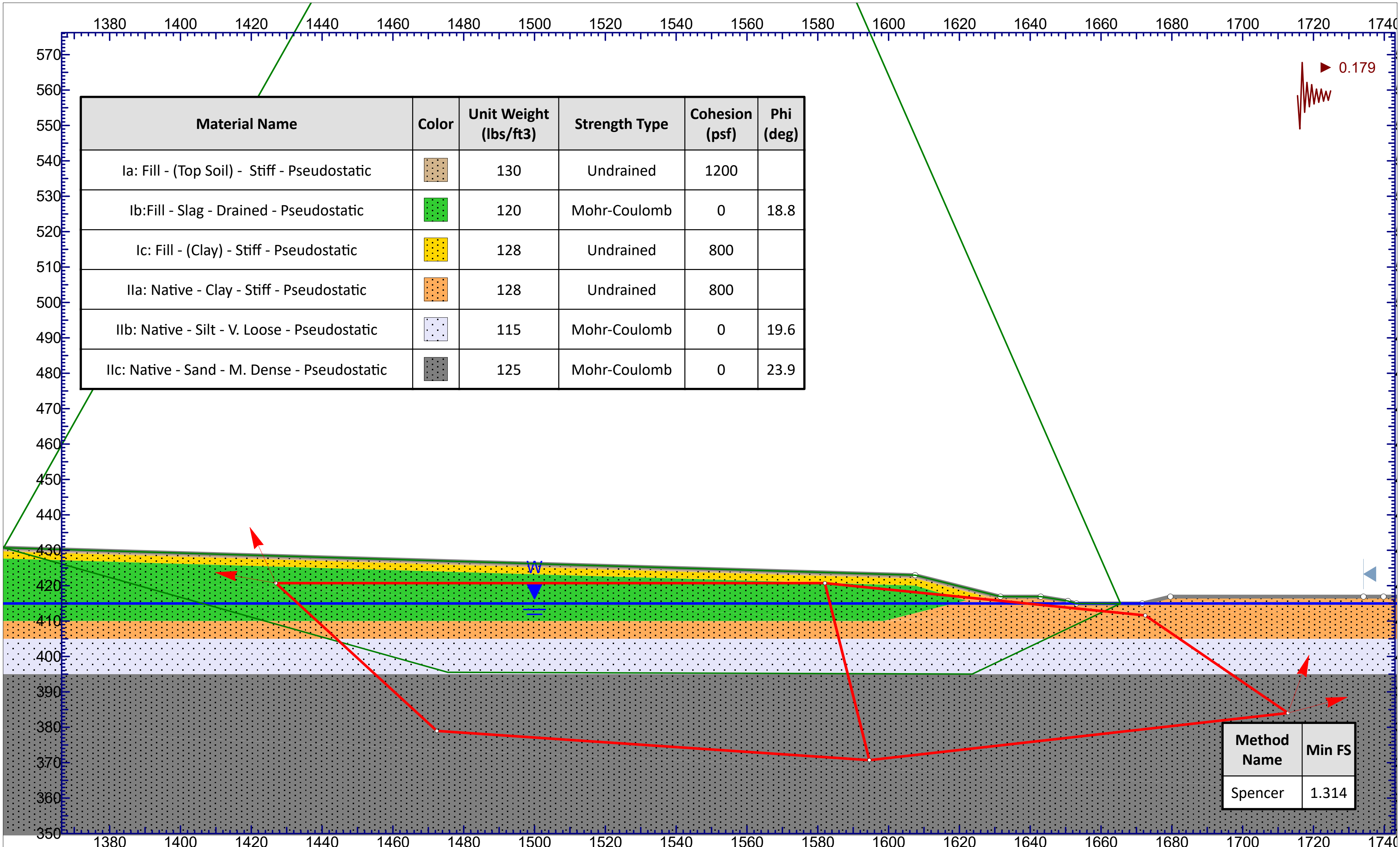



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Pseudostatic | | 130 | Undrained | 1200 | |
| Ib:Fill - Slag - Drained - Pseudostatic | | 120 | Mohr-Coulomb | 0 | 18.8 |
| Ic: Fill - (Clay) - Stiff - Pseudostatic | | 128 | Undrained | 800 | |
| IIa: Native - Clay - Stiff - Pseudostatic | | 128 | Undrained | 800 | |
| IIb: Native - Silt - V. Loose - Pseudostatic | | 115 | Mohr-Coulomb | 0 | 19.6 |
| IIc: Native - Sand - M. Dense - Pseudostatic | | 125 | Mohr-Coulomb | 0 | 23.9 |

| Method Name | Min FS |
|---|---|
| Spencer | 1.328 |

| | | | |
|---|---|---|---|
| *Project* | Old American Zinc | | |
| *Analysis Description* | Section A-Undrained-Pseudostatic - Circular | | |
| *Drawn By* | P. Toloza | *Scale* | 1:450 |
| *Company* | CH2M | | |
| *Date* | 03-27-2018 | *File Name* | OAZ_New Section A.slmd |

SLIDEINTERPRET 7.033



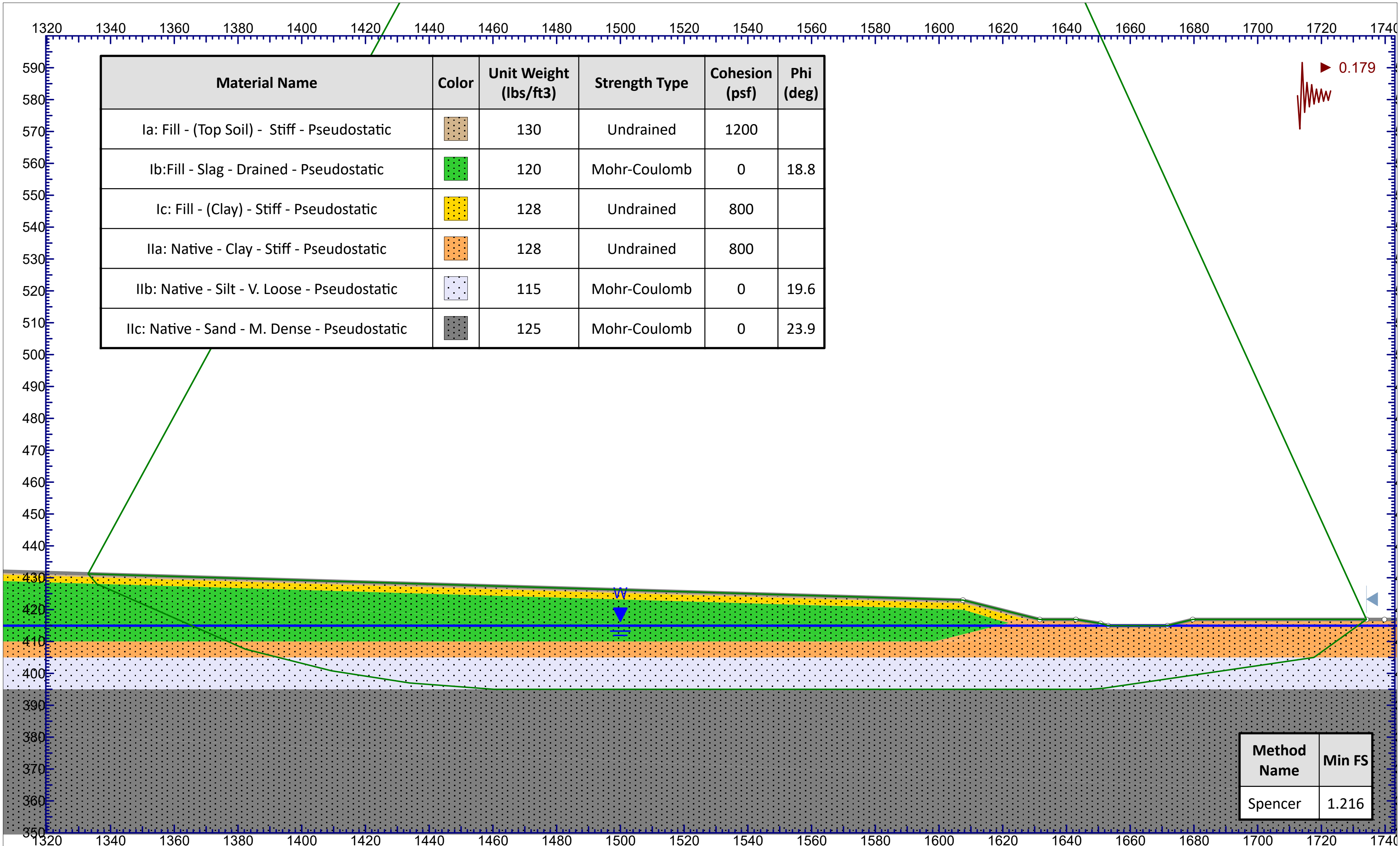

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Pseudostatic | | 130 | Undrained | 1200 | |
| Ib:Fill - Slag - Drained - Pseudostatic | | 120 | Mohr-Coulomb | 0 | 18.8 |
| Ic: Fill - (Clay) - Stiff - Pseudostatic | | 128 | Undrained | 800 | |
| IIa: Native - Clay - Stiff - Pseudostatic | | 128 | Undrained | 800 | |
| IIb: Native - Silt - V. Loose - Pseudostatic | | 115 | Mohr-Coulomb | 0 | 19.6 |
| IIc: Native - Sand - M. Dense - Pseudostatic | | 125 | Mohr-Coulomb | 0 | 23.9 |

| Method Name | Min FS |
|---|---|
| Spencer | 1.314 |

ch2m SM

SLIDEINTERPRET 7.033

| | | | |
|---|---|---|---|
| *Project* | Old American Zinc | | |
| *Analysis Description* | Section A-Undrained-Pseudostatic - Block | | |
| *Drawn By* P. Toloza | *Scale* 1:450 | *Company* | CH2M |
| *Date* | 03-27-2018 | *File Name* | OAZ_New Section A.slmd |



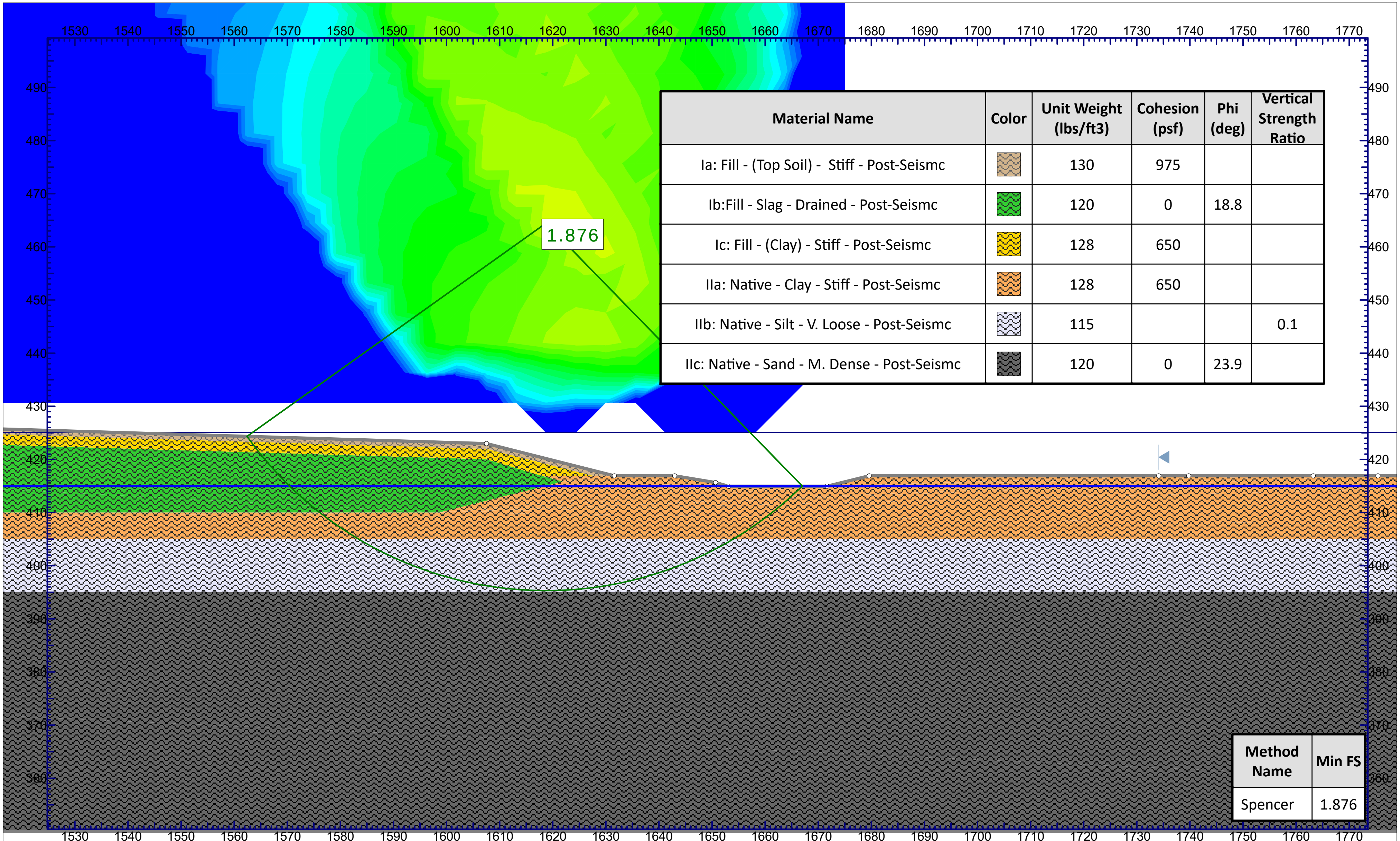

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Pseudostatic | | 130 | Undrained | 1200 | |
| Ib:Fill - Slag - Drained - Pseudostatic | | 120 | Mohr-Coulomb | 0 | 18.8 |
| Ic: Fill - (Clay) - Stiff - Pseudostatic | | 128 | Undrained | 800 | |
| IIa: Native - Clay - Stiff - Pseudostatic | | 128 | Undrained | 800 | |
| IIb: Native - Silt - V. Loose - Pseudostatic | | 115 | Mohr-Coulomb | 0 | 19.6 |
| IIc: Native - Sand - M. Dense - Pseudostatic | | 125 | Mohr-Coulomb | 0 | 23.9 |

| Method Name | Min FS |
|---|---|
| Spencer | 1.216 |

SLIDEINTERPRET 7.033

| | |
|---|---|
| *Project* | Old American Zinc |
| *Analysis Description* | Section A-Undrained-Pseudostatic - Non-Circular 1 |
| *Drawn By* | P. Toloza |
| *Scale* | 1:500 |
| *Company* | CH2M |
| *Date* | 03-27-2018 |
| *File Name* | OAZ_New Section A.slmd |

# Case 4: Post-seismic Residual



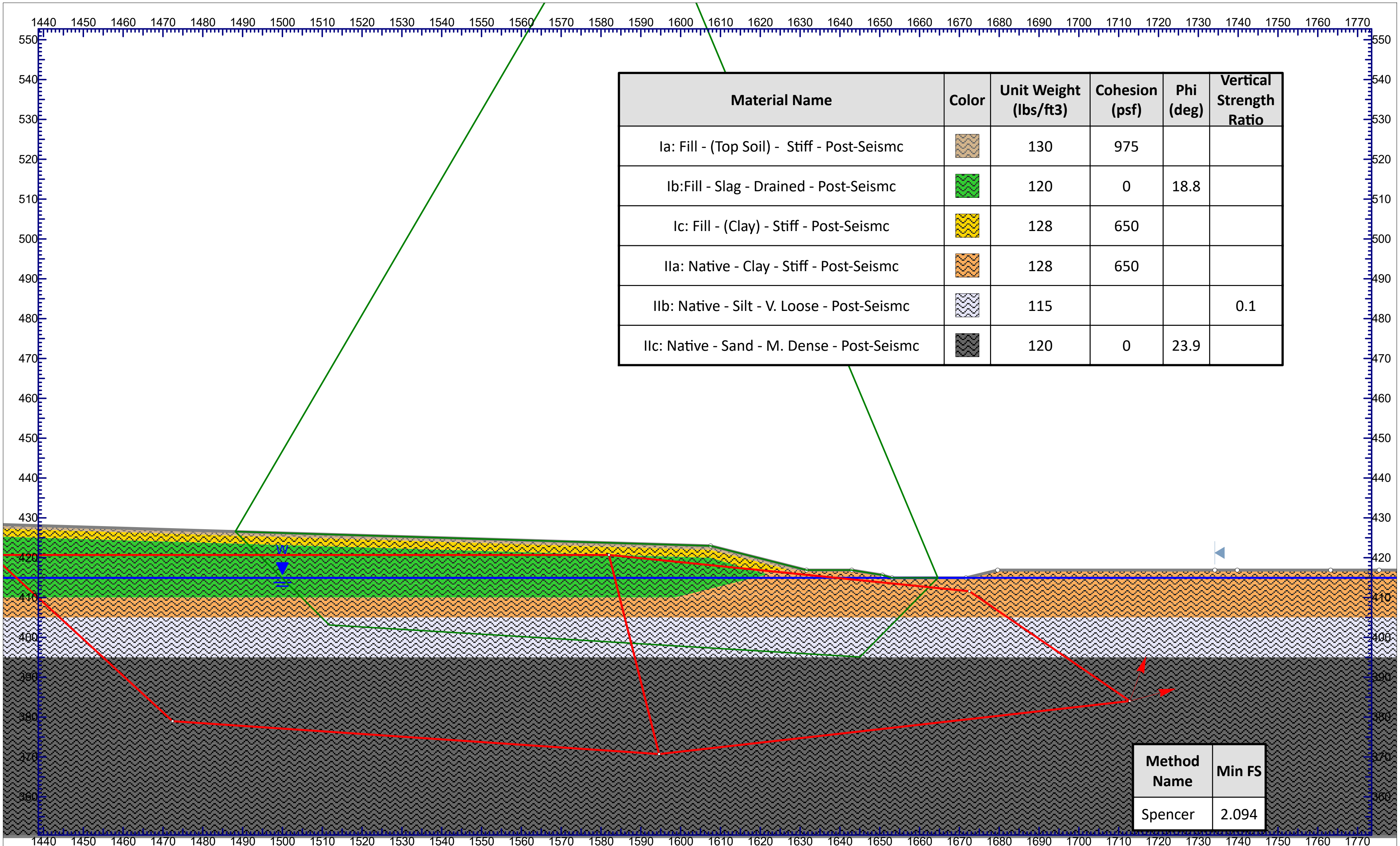

| Material Name | Color | Unit Weight (lbs/ft3) | Cohesion (psf) | Phi (deg) | Vertical Strength Ratio |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Post-Seismc | | 130 | 975 | | |
| Ib:Fill - Slag - Drained - Post-Seismc | | 120 | 0 | 18.8 | |
| Ic: Fill - (Clay) - Stiff - Post-Seismc | | 128 | 650 | | |
| IIa: Native - Clay - Stiff - Post-Seismc | | 128 | 650 | | |
| IIb: Native - Silt - V. Loose - Post-Seismc | | 115 | | | 0.1 |
| IIc: Native - Sand - M. Dense - Post-Seismc | | 120 | 0 | 23.9 | |

| Method Name | Min FS |
|---|---|
| Spencer | 1.876 |

ch2m SM

SLIDEINTERPRET 7.033

| | |
|---|---|
| *Project* | Old American Zinc |
| *Analysis Description* | Section A-Post-Seismic Residual - Circular |
| *Drawn By* | P. Toloza |
| *Scale* | 1:300 |
| *Company* | CH2M |
| *Date* | 03-27-2018 |
| *File Name* | OAZ_New Section A_Post seimic.slmd |

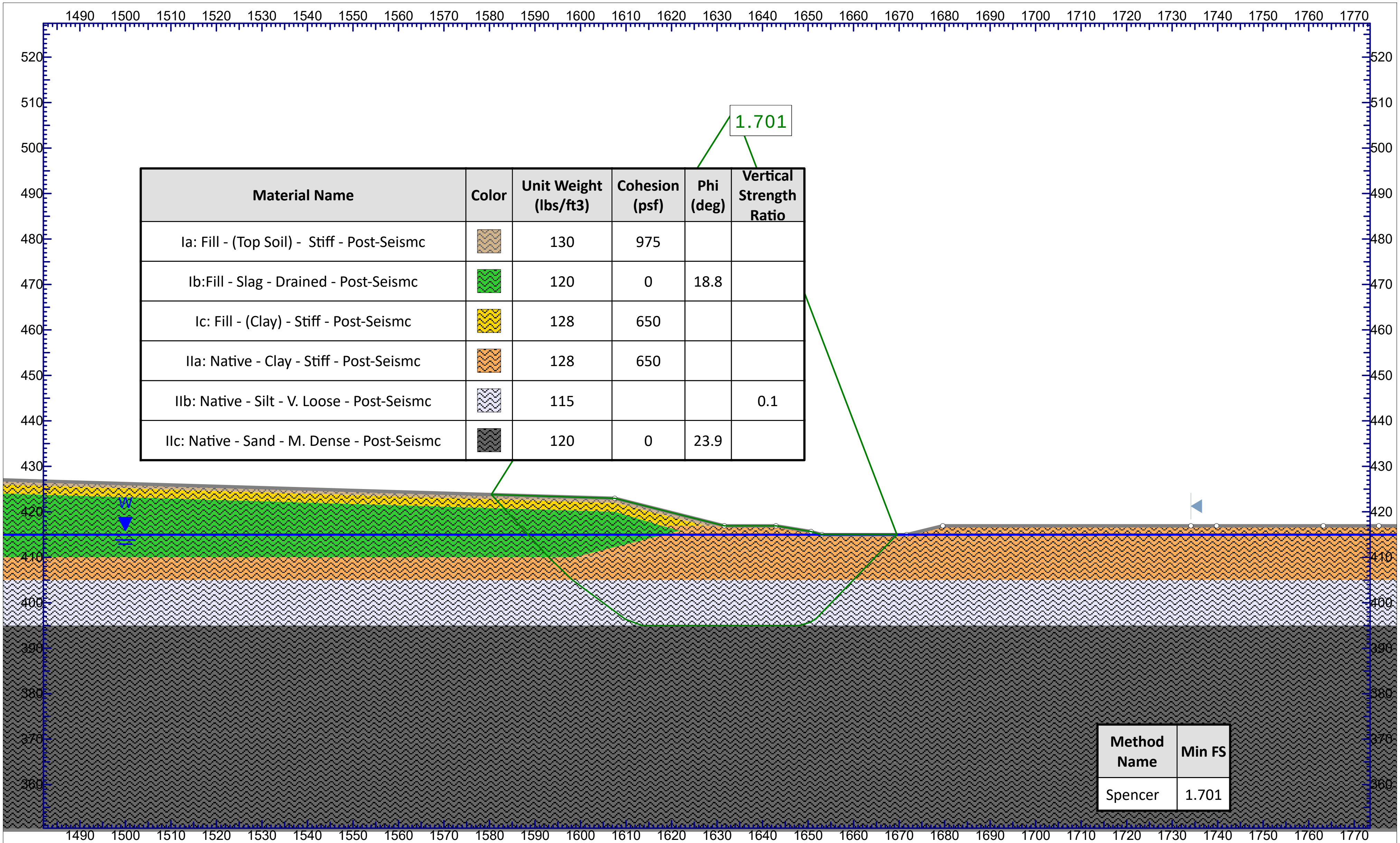



| Material Name | Color | Unit Weight (lbs/ft3) | Cohesion (psf) | Phi (deg) | Vertical Strength Ratio |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Post-Seismc | | 130 | 975 | | |
| Ib:Fill - Slag - Drained - Post-Seismc | | 120 | 0 | 18.8 | |
| Ic: Fill - (Clay) - Stiff - Post-Seismc | | 128 | 650 | | |
| IIa: Native - Clay - Stiff - Post-Seismc | | 128 | 650 | | |
| IIb: Native - Silt - V. Loose - Post-Seismc | | 115 | | | 0.1 |
| IIc: Native - Sand - M. Dense - Post-Seismc | | 120 | 0 | 23.9 | |

| Method Name | Min FS |
|---|---|
| Spencer | 2.094 |

| | |
|---|---|
| Project | Old American Zinc |
| Analysis Description | Section A-Post-Seismic Residual - Block |
| Drawn By | P. Toloza |
| Scale | 1:400 |
| Company | CH2M |
| Date | 03-27-2018 |
| File Name | OAZ_New Section A_Post seimic.slmd |

SLIDEINTERPRET 7.033




| Material Name | Color | Unit Weight (lbs/ft3) | Cohesion (psf) | Phi (deg) | Vertical Strength Ratio |
|---|---|---|---|---|---|
| Ia: Fill - (Top Soil) - Stiff - Post-Seismc | | 130 | 975 | | |
| Ib:Fill - Slag - Drained - Post-Seismc | | 120 | 0 | 18.8 | |
| Ic: Fill - (Clay) - Stiff - Post-Seismc | | 128 | 650 | | |
| IIa: Native - Clay - Stiff - Post-Seismc | | 128 | 650 | | |
| IIb: Native - Silt - V. Loose - Post-Seismc | | 115 | | | 0.1 |
| IIc: Native - Sand - M. Dense - Post-Seismc | | 120 | 0 | 23.9 | |

| Method Name | Min FS |
|---|---|
| Spencer | 1.701 |

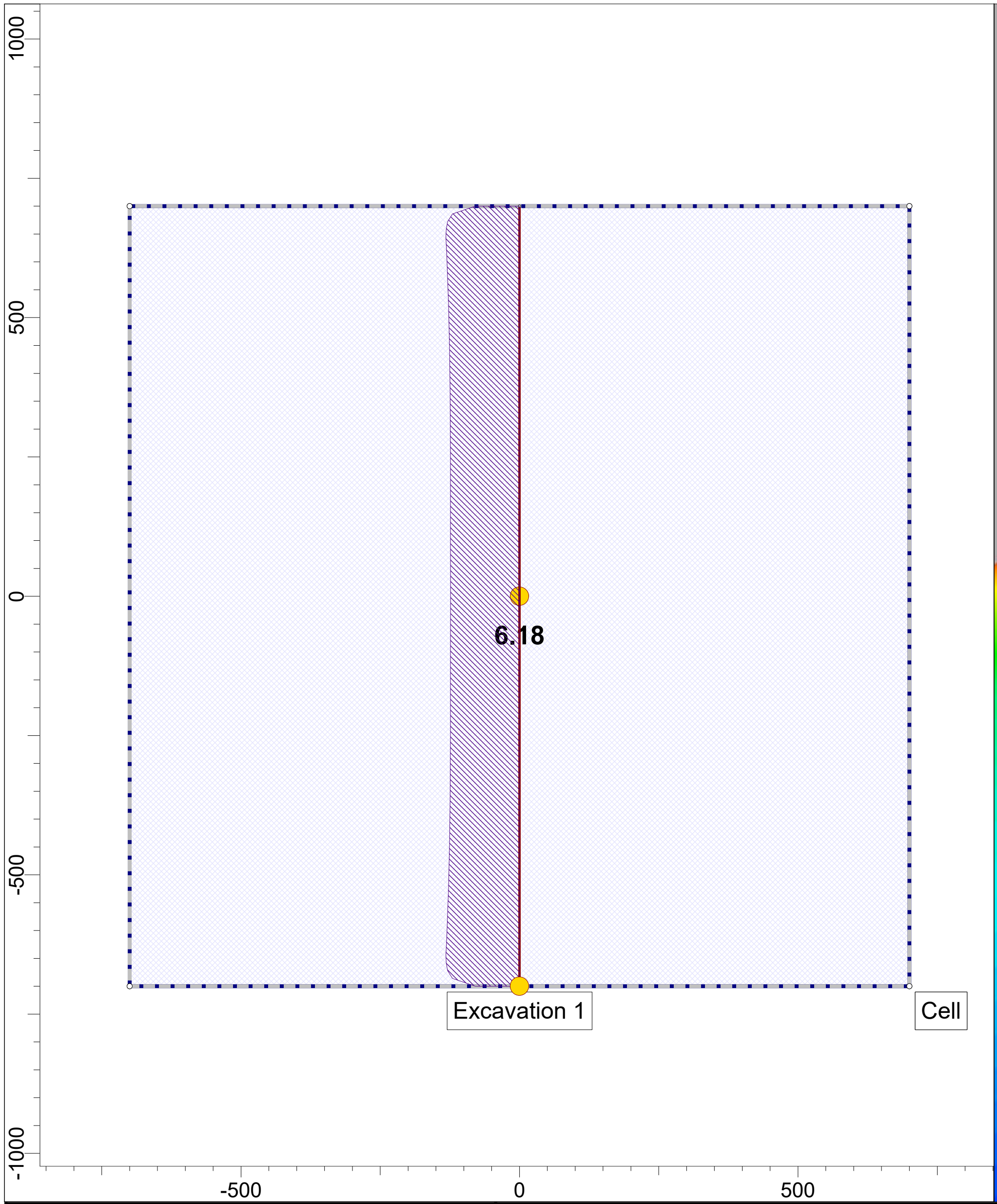
ch2m SM

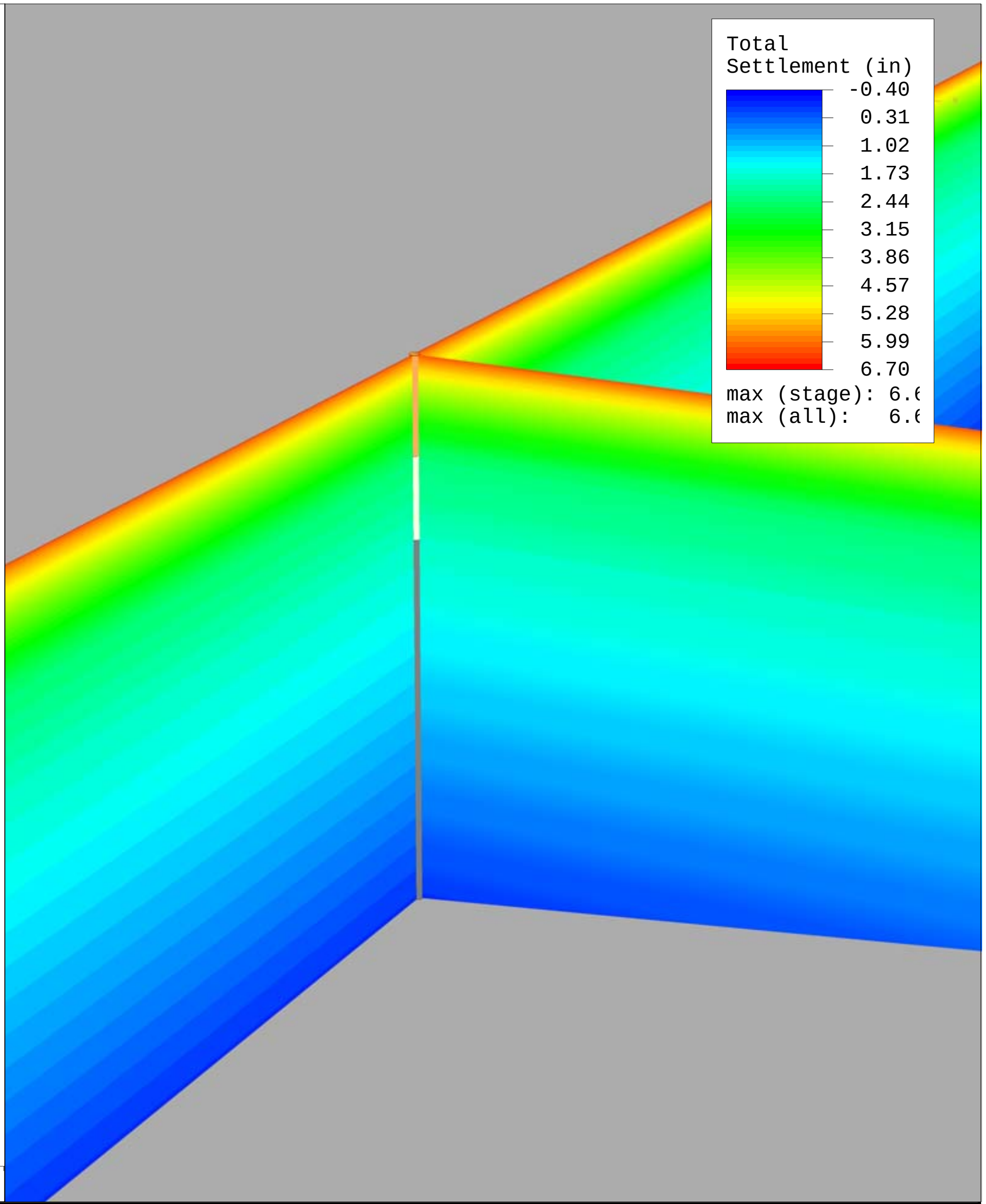
SLIDEINTERPRET 7.033

| | |
|---|---|
| *Project* | Old American Zinc |
| *Analysis Description* | Section A-Post-Seismic Residual - Non-Circular 1 |
| *Drawn By* | P. Toloza |
| *Scale* | 1:350 |
| *Company* | CH2M |
| *Date* | 03-27-2018 |
| *File Name* | OAZ_New Section A_Post seimic.slmd |

# Attachment C

# Settlement Analyses




| | | | |
|---|---|---|---|
| Project | Old American Zinc | | |
| Analysis Description | Cell | | |
| Drawn By | P. Toloza | Company | CH2M |
| Date | 2018-04-16 | File Name | OAZ_cell.s3z |

SETTLE3D 4.016

# Settle3D Analysis Information
# Old American Zinc

## Project Settings

| | |
|---|---|
| Document Name | OAZ_cell.s3z |
| Project Title | Old American Zinc |
| Analysis | Cell |
| Author | P. Toloza |
| Company | CH2M |
| Date Created | 2018-04-16 |
| Stress Computation Method | Boussinesq |
| Time-dependent Consolidation Analysis | |
| Time Units | months |
| Permeability Units | inches/minute |
| Minimum settlement ratio for subgrade modulus | 0.9 |

Calculate settlement with mean stress

Use average properties to calculate layered stresses

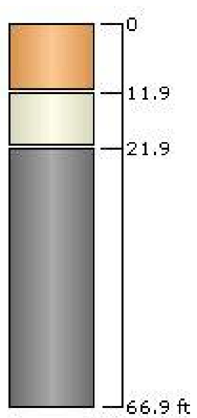
Improve consolidation accuracy

Ignore negative effective stresses in settlement calculations

## Soil Layers

Ground Surface Drained: Yes

| Layer # | Type | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---|---|---|---|---|
| 1 | 1: Clay (Stiff) | 11.9 | 0 | Yes |
| 2 | 2: Sand/Silt (Loose) | 10 | 11.9 | Yes |
| 3 | 3: Sand/Silt (M. Dense) | 45 | 21.9 | No |



## *Soil Properties*

| Property | 1: Clay (Stiff) | 2: Sand/Silt (Loose) | 3: Sand/Silt (M. Dense) |
|---|---|---|---|
| Color | | | |
| Unit Weight [kips/ft$^3$] | 0.129 | 0.12 | 0.125 |
| Saturated Unit Weight [kips/ft$^3$] | 0.13 | 0.125 | 0.13 |
| Poisson's Ratio | 0.35 | 0.35 | 0.35 |
| K0 | 0.607 | 0.531 | 0.426 |
| Immediate Settlement | Disabled | Enabled | Enabled |
| E [ksf] | - | 200 | 320 |
| Eur [ksf] | - | 600 | 960 |
| Primary Consolidation | Enabled | Disabled | Disabled |
| Material Type | Non-Linear | | |
| Cc | 0.5 | - | - |
| Cr | 0.05 | - | - |
| e0 | 0.6569 | - | - |
| Pc [ksf] | 4 | - | - |
| Cv [in$^2$/min] | 0.00372 | - | - |
| Cvr [in$^2$/min] | 0.00372 | - | - |
| B-bar | 1 | - | - |
| Undrained Su A [kips/ft2] | 0 | 0 | 0 |
| Undrained Su S | 0.2 | 0.2 | 0.2 |
| Undrained Su m | 0.8 | 0.8 | 0.8 |
| Piezo Line ID | 1 | 1 | 1 |

## *Groundwater*

| | |
|---|---|
| Groundwater method | Piezometric Lines |
| Water Unit Weight | 0.0624 kips/ft$^3$ |

### Piezometric Line Entities

| ID | Depth (ft) |
|---|---|
| 1 | 1.941 ft |

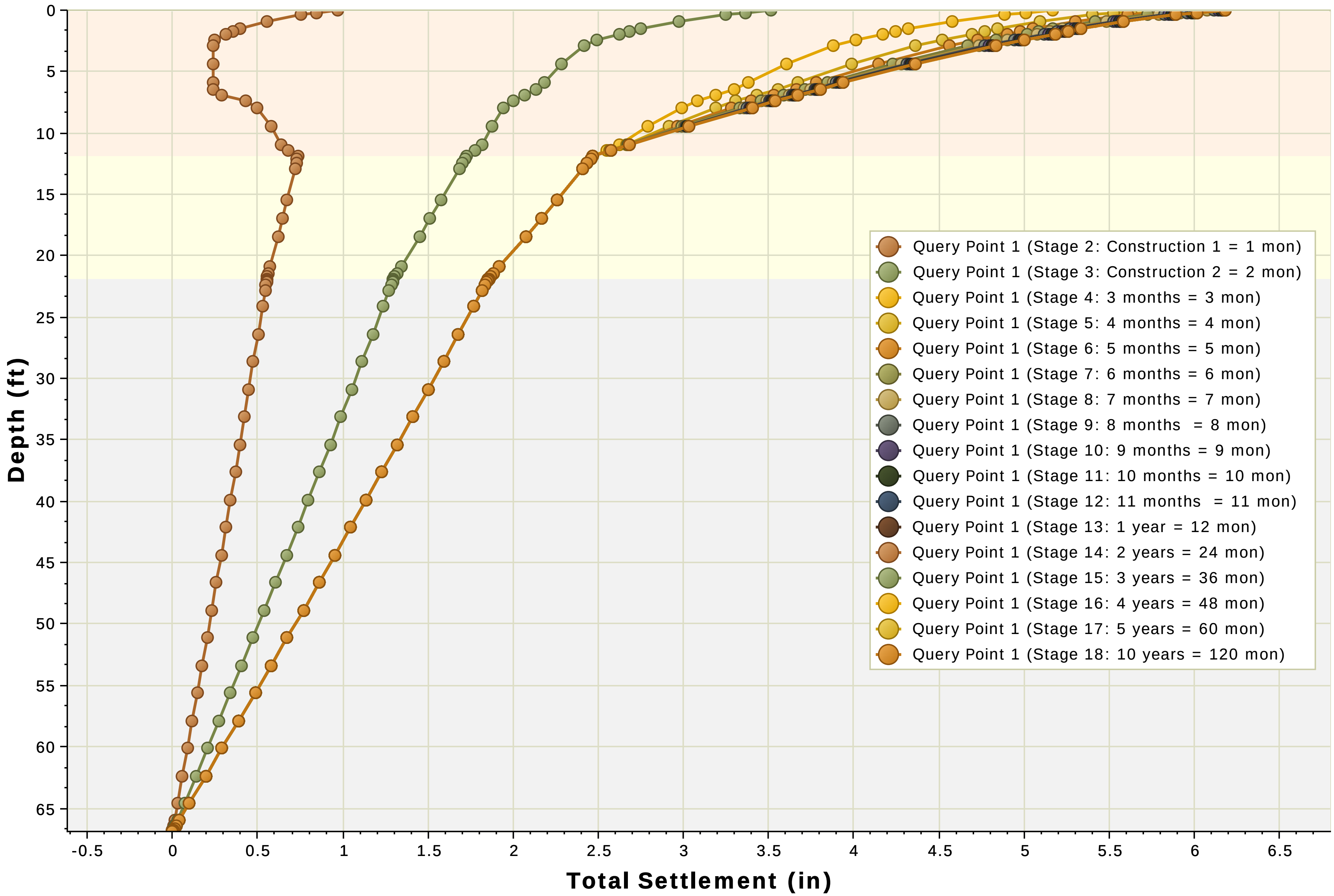
## *Query Points*

| Point # | Query Point Name | (X,Y) Location | Number of Divisions |
|---|---|---|---|
| 1 | Point | 0, 0 | Auto: 59 |

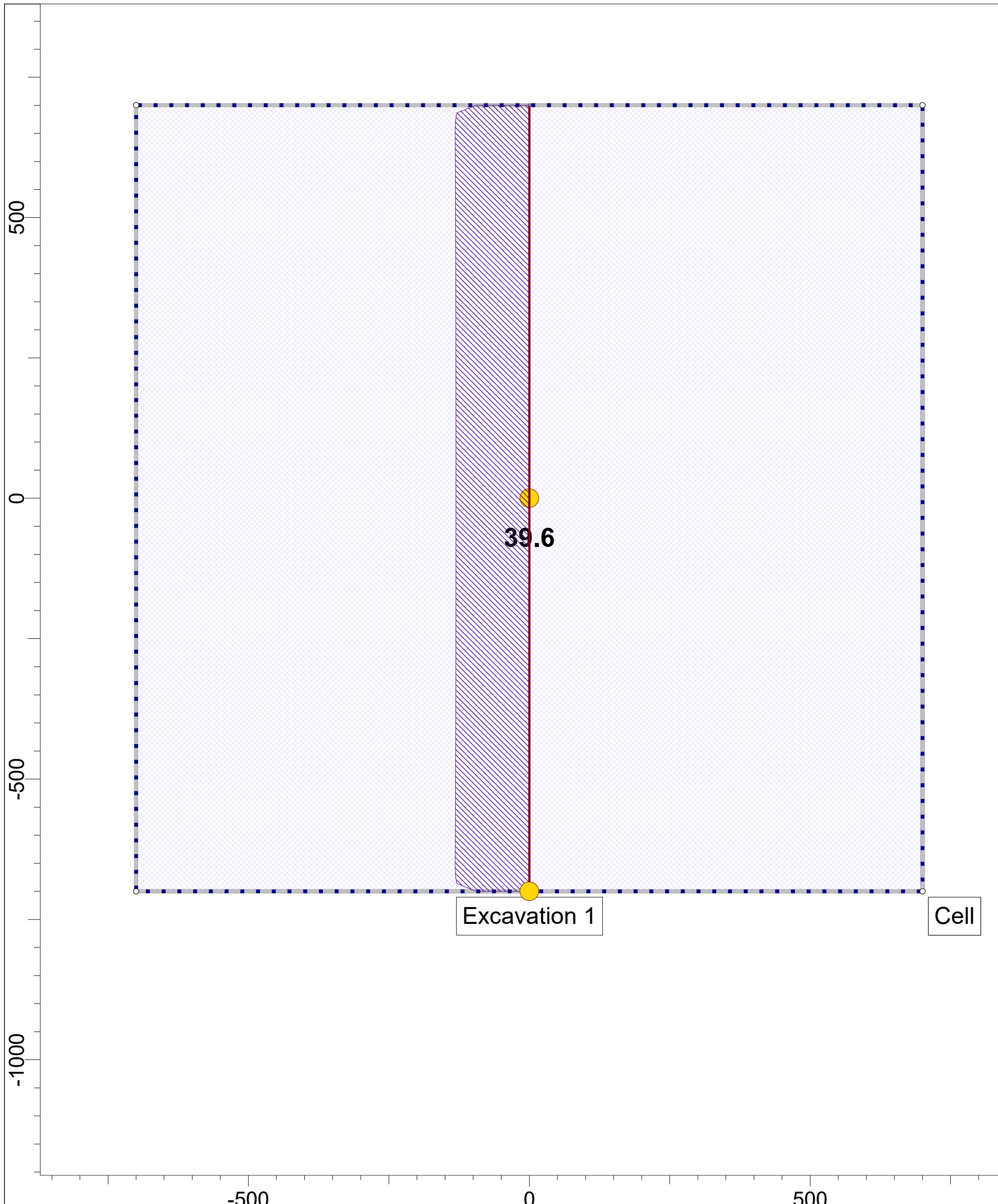
## *Query Lines*

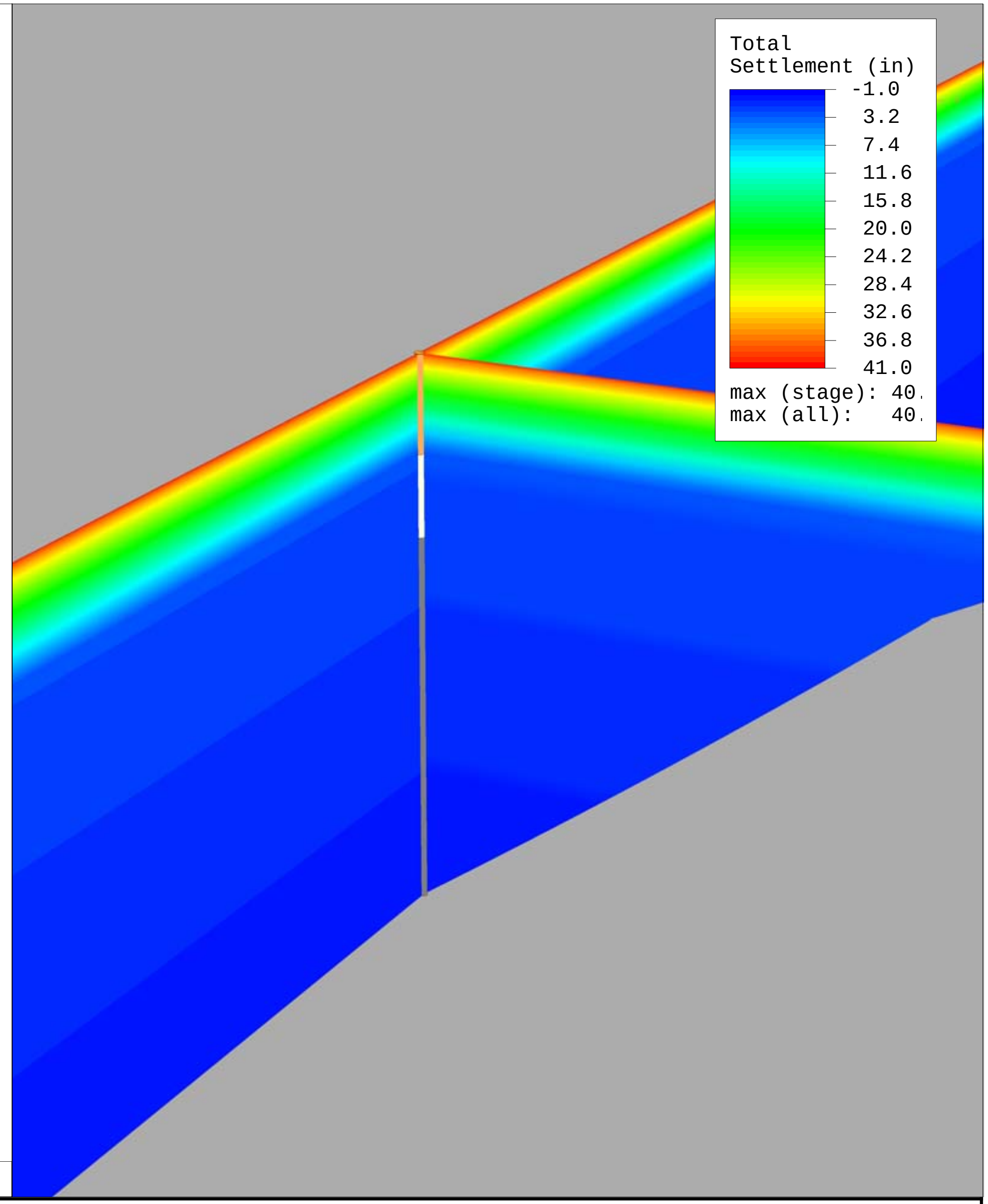
| Line # | Query Line Name | Start Location | End Location | Horizontal Divisions | Vertical Divisions |
|---|---|---|---|---|---|
| 1 | Line | 0, -700 | 0, 700 | 100 | Auto: 59 |

# Total Settlement vs. Depth




Reference Stage: None




| | | | |
|---|---|---|---|
| SETTLE3D 4.016 | Project | Old American Zinc | |
| | Analysis Description | Cell | |
| | Drawn By | P. Toloza | Company: CH2M |
| | Date | 2018-04-16 | File Name: OAZ_cell_NC.s3z |

# Settle3D Analysis Information
# Old American Zinc

## Project Settings

| | |
|---|---|
| Document Name | OAZ_cell_NC.s3z |
| Project Title | Old American Zinc |
| Analysis | Cell |
| Author | P. Toloza |
| Company | CH2M |
| Date Created | 2018-04-16 |
| Stress Computation Method | Boussinesq |
| Time-dependent Consolidation Analysis | |
| Time Units | months |
| Permeability Units | inches/minute |
| Minimum settlement ratio for subgrade modulus | 0.9 |

Calculate settlement with mean stress

Use average properties to calculate layered stresses

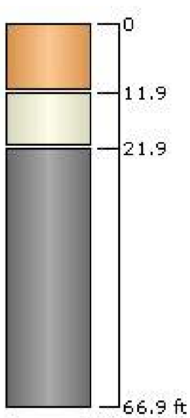
Improve consolidation accuracy

Ignore negative effective stresses in settlement calculations

## Soil Layers

Ground Surface Drained: Yes

| Layer # | Type | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---|---|---|---|---|
| 1 | 1: Clay (Stiff) | 11.9 | 0 | Yes |
| 2 | 2: Sand/Silt (Loose) | 10 | 11.9 | Yes |
| 3 | 3: Sand/Silt (M. Dense) | 45 | 21.9 | No |



## Soil Properties

| Property | 1: Clay (Stiff) | 2: Sand/Silt (Loose) | 3: Sand/Silt (M. Dense) |
|---|---|---|---|
| Color | | | |
| Unit Weight [kips/ft$^3$] | 0.129 | 0.12 | 0.125 |
| Saturated Unit Weight [kips/ft$^3$] | 0.13 | 0.125 | 0.13 |
| Poisson's Ratio | 0.35 | 0.35 | 0.35 |
| K0 | 0.607 | 0.531 | 0.426 |
| | | | |
| Immediate Settlement | Disabled | Enabled | Enabled |
| E [ksf] | - | 200 | 320 |
| Eur [ksf] | - | 600 | 960 |
| | | | |
| Primary Consolidation | Enabled | Disabled | Disabled |
| Material Type | Non-Linear | | |
| Cc | 0.5 | - | - |
| Cr | 0.05 | - | - |
| e0 | 0.6569 | - | - |
| OCR | 1 | - | - |
| Cv [in$^2$/min] | 0.00372 | - | - |
| Cvr [in$^2$/min] | 0.00372 | - | - |
| B-bar | 1 | - | - |
| | | | |
| Undrained Su A [kips/ft2] | 0 | 0 | 0 |
| Undrained Su S | 0.2 | 0.2 | 0.2 |
| Undrained Su m | 0.8 | 0.8 | 0.8 |
| Piezo Line ID | 1 | 1 | 1 |

## Groundwater

| | |
|---|---|
| Groundwater method | Piezometric Lines |
| Water Unit Weight | 0.0624 kips/ft$^3$ |

### Piezometric Line Entities

| ID | Depth (ft) |
|---|---|
| 1 | 1.941 ft |

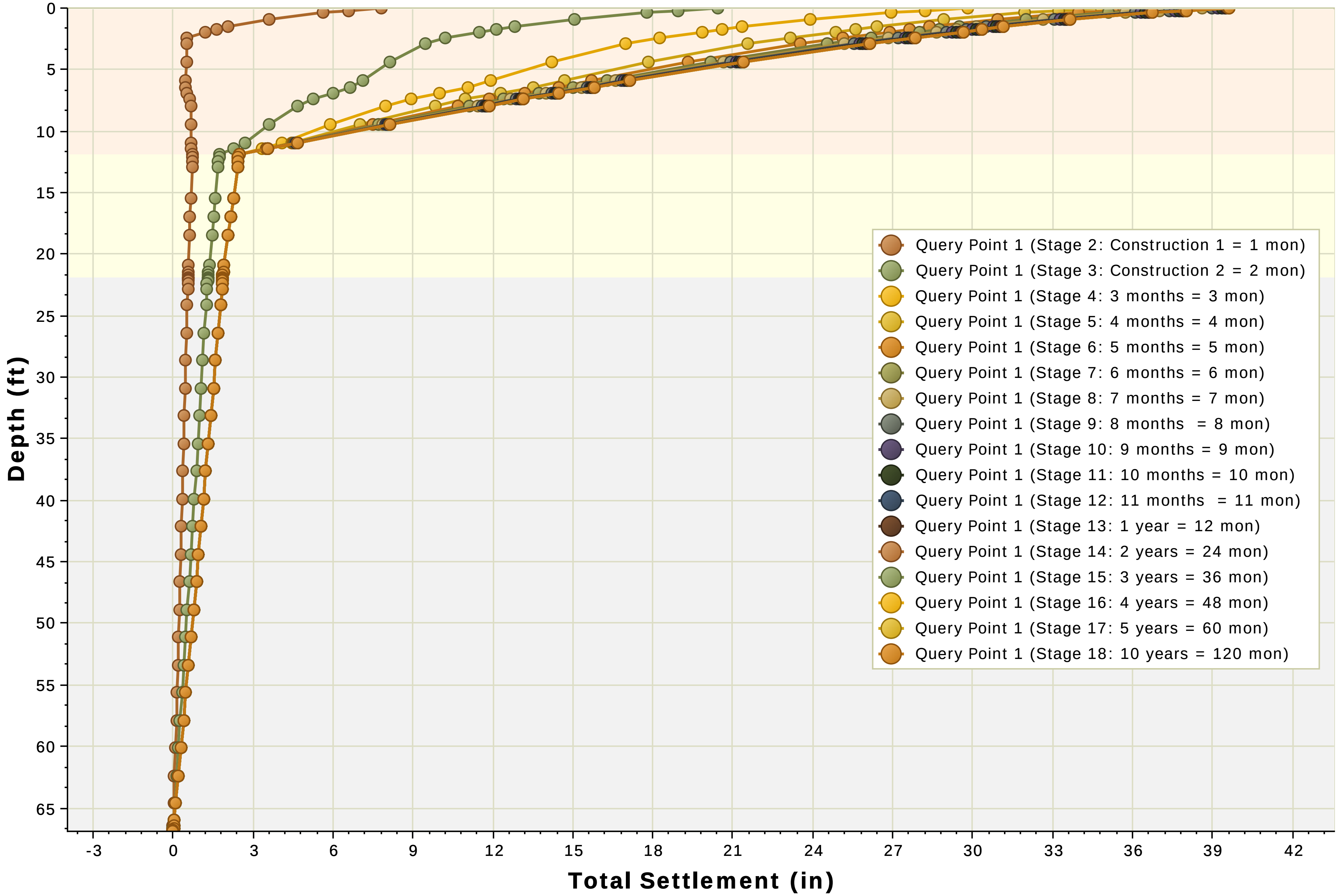
## Query Points

| Point # | Query Point Name | (X,Y) Location | Number of Divisions |
|---|---|---|---|
| 1 | Point | 0, 0 | Auto: 59 |

## Query Lines

| Line # | Query Line Name | Start Location | End Location | Horizontal Divisions | Vertical Divisions |
|---|---|---|---|---|---|
| 1 | Line | 0, -700 | 0, 700 | 100 | Auto: 59 |

# Total Settlement vs. Depth




Reference Stage: None

# Attachment D

# Seismicity Data

# Design Maps Summary Report

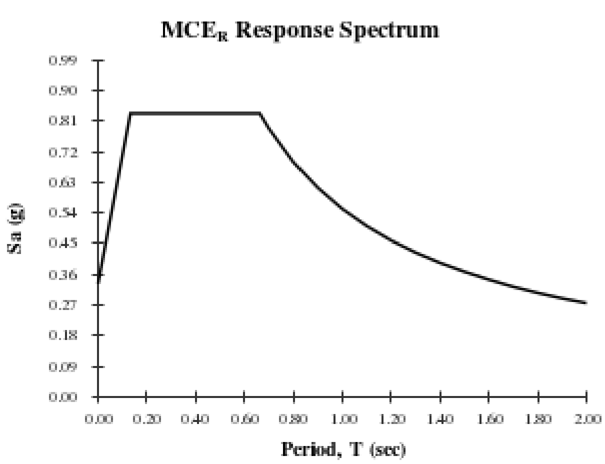
## User–Specified Input

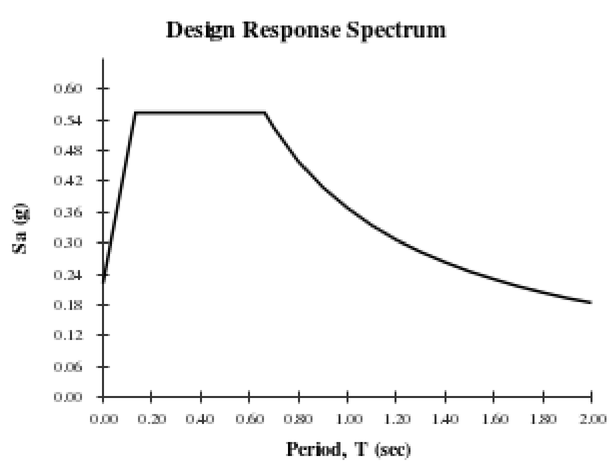
| | |
|---|---|
| **Report Title** | Old American Zinc<br>Wed April 18, 2018 19:57:30 UTC |
| **Building Code Reference Document** | ASCE 7-10 Standard<br>(which utilizes USGS hazard data available in 2008) |
| **Site Coordinates** | 38.64569°N, 90.10739°W |
| **Site Soil Classification** | Site Class E – “Soft Clay Soil” |
| **Risk Category** | IV (e.g. essential facilities) |


## USGS–Provided Output

| | | | | | |
|---|---|---|---|---|---|
| $S_S$ = | 0.438 g | $S_{MS}$ = | 0.832 g | $S_{DS}$ = | 0.554 g |
| $S_1$ = | 0.167 g | $S_{M1}$ = | 0.551 g | $S_{D1}$ = | 0.368 g |

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the “2009 NEHRP” building code reference document.




For $PGA_M$, $T_L$, $C_{RS}$, and $C_{R1}$ values, please view the detailed report.

# Design Maps Detailed Report

## ASCE 7-10 Standard (38.64569°N, 90.10739°W)

Site Class E – "Soft Clay Soil", Risk Category IV (e.g. essential facilities)

### Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain $S_S$) and 1.3 (to obtain $S_1$). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

| | |
|---|---|
| **From Figure 22-1** [1] | $S_S$ = 0.438 g |
| **From Figure 22-2** [2] | $S_1$ = 0.167 g |

### Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class E, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

| Site Class | $\bar{v}_s$ | $\bar{N}$ or $\bar{N}_{ch}$ | $\bar{s}_u$ |
|---|---|---|---|
| A. Hard Rock | >5,000 ft/s | N/A | N/A |
| B. Rock | 2,500 to 5,000 ft/s | N/A | N/A |
| C. Very dense soil and soft rock | 1,200 to 2,500 ft/s | >50 | >2,000 psf |
| D. Stiff Soil | 600 to 1,200 ft/s | 15 to 50 | 1,000 to 2,000 psf |
| E. Soft clay soil | <600 ft/s | <15 | <1,000 psf |
| | Any profile with more than 10 ft of soil having the characteristics:<br>• Plasticity index *PI* > 20,<br>• Moisture content *w* ≥ 40%, and<br>• Undrained shear strength $\bar{s}_u$ < 500 psf | | |
| F. Soils requiring site response analysis in accordance with Section 21.1 | See Section 20.3.1 | | |

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

## Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake ($MCE_R$) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient $F_a$

| Site Class | Mapped $MCE_R$ Spectral Response Acceleration Parameter at Short Period | | | | |
|---|---|---|---|---|---|
| | $S_S \leq 0.25$ | $S_S = 0.50$ | $S_S = 0.75$ | $S_S = 1.00$ | $S_S \geq 1.25$ |
| A | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| B | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| C | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| D | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 |
| E | 2.5 | 1.7 | 1.2 | 0.9 | 0.9 |
| F | See Section 11.4.7 of ASCE 7 | | | | |

Note: Use straight–line interpolation for intermediate values of $S_S$

**For Site Class = E and $S_S$ = 0.438 g, $F_a$ = 1.898**

Table 11.4–2: Site Coefficient $F_v$

| Site Class | Mapped $MCE_R$ Spectral Response Acceleration Parameter at 1–s Period | | | | |
|---|---|---|---|---|---|
| | $S_1 \leq 0.10$ | $S_1 = 0.20$ | $S_1 = 0.30$ | $S_1 = 0.40$ | $S_1 \geq 0.50$ |
| A | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| B | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| C | 1.7 | 1.6 | 1.5 | 1.4 | 1.3 |
| D | 2.4 | 2.0 | 1.8 | 1.6 | 1.5 |
| E | 3.5 | 3.2 | 2.8 | 2.4 | 2.4 |
| F | See Section 11.4.7 of ASCE 7 | | | | |

Note: Use straight–line interpolation for intermediate values of $S_1$

**For Site Class = E and $S_1$ = 0.167 g, $F_v$ = 3.299**

**Equation (11.4–1):** $S_{MS} = F_aS_S = 1.898 \times 0.438 = 0.832$ g

**Equation (11.4–2):** $S_{M1} = F_vS_1 = 3.299 \times 0.167 = 0.551$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

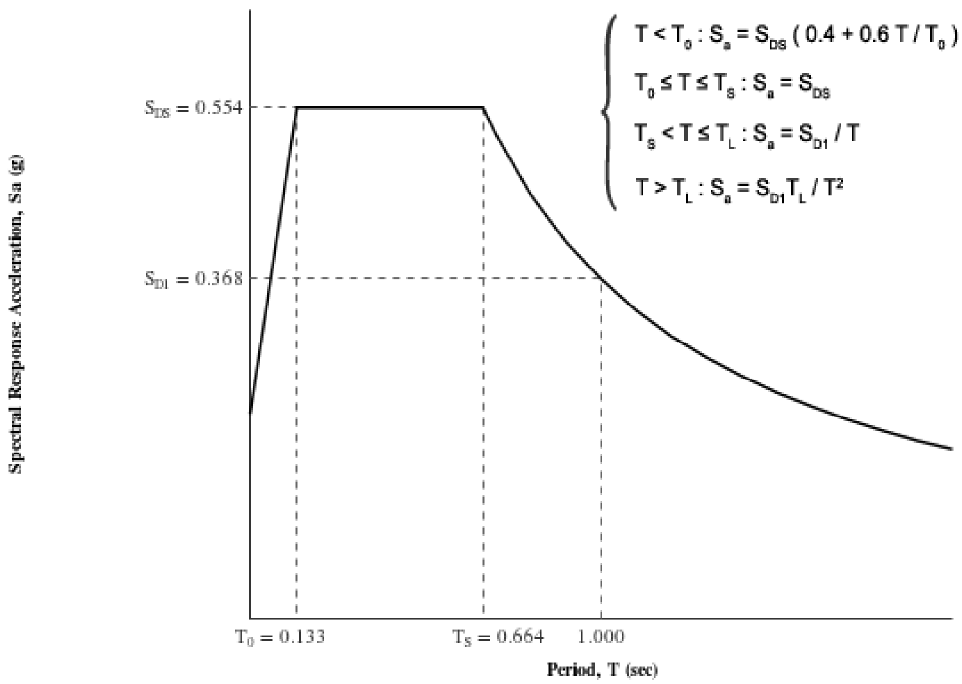
**Equation (11.4–3):** $S_{DS} = ⅔ S_{MS} = ⅔ \times 0.832 = 0.554$ g

**Equation (11.4–4):** $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.551 = 0.368$ g

Section 11.4.5 — Design Response Spectrum

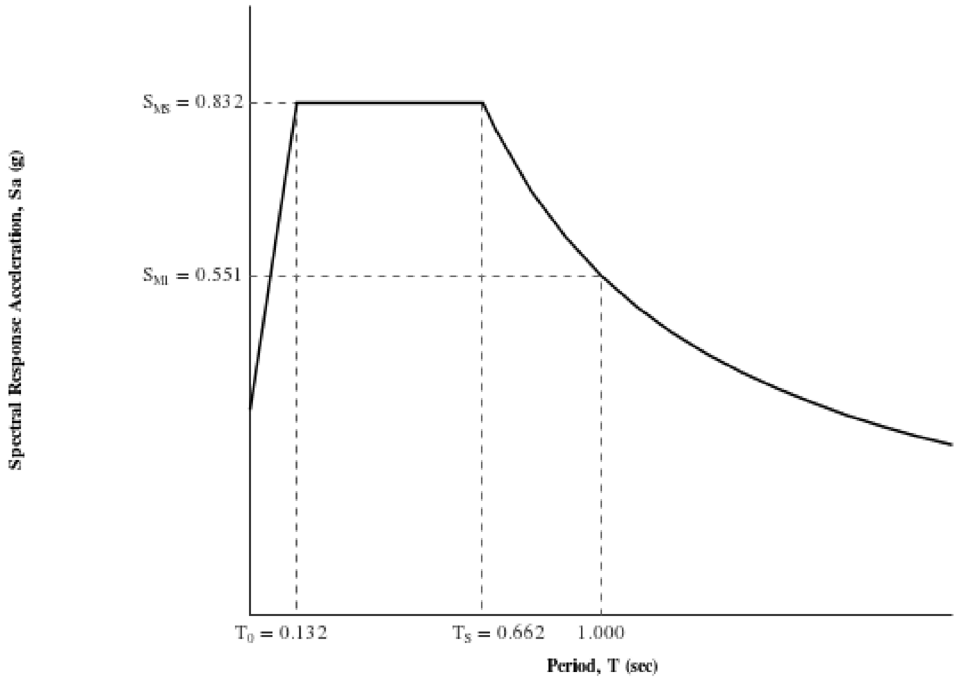
**From Figure 22-12** [3] $T_L$ = 12 seconds

Figure 11.4–1: Design Response Spectrum



## Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake ($MCE_R$) Response Spectrum

The $MCE_R$ Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

**From Figure 22-7** [4] PGA = 0.230

**Equation (11.8–1):** $PGA_M = F_{PGA}PGA = 1.550 \times 0.230 = 0.357$ g

Table 11.8–1: Site Coefficient $F_{PGA}$

| Site Class | Mapped MCE Geometric Mean Peak Ground Acceleration, PGA | | | | |
|---|---|---|---|---|---|
| | PGA ≤ 0.10 | PGA = 0.20 | PGA = 0.30 | PGA = 0.40 | PGA ≥ 0.50 |
| A | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| B | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| C | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| D | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 |
| E | 2.5 | 1.7 | 1.2 | 0.9 | 0.9 |
| F | See Section 11.4.7 of ASCE 7 | | | | |

Note: Use straight–line interpolation for intermediate values of PGA

**For Site Class = E and PGA = 0.230 g, $F_{PGA}$ = 1.550**

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

**From Figure 22-17** [5] $C_{RS}$ = 0.867

**From Figure 22-18** [6] $C_{R1}$ = 0.833

## Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

| VALUE OF $S_{DS}$ | RISK CATEGORY | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{DS} < 0.167g$ | A | A | A |
| $0.167g \le S_{DS} < 0.33g$ | B | B | C |
| $0.33g \le S_{DS} < 0.50g$ | C | C | D |
| $0.50g \le S_{DS}$ | D | D | D |

**For Risk Category = IV and $S_{DS}$ = 0.554 g, Seismic Design Category = D**

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

| VALUE OF $S_{D1}$ | RISK CATEGORY | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{D1} < 0.067g$ | A | A | A |
| $0.067g \le S_{D1} < 0.133g$ | B | B | C |
| $0.133g \le S_{D1} < 0.20g$ | C | C | D |
| $0.20g \le S_{D1}$ | D | D | D |

**For Risk Category = IV and $S_{D1}$ = 0.368 g, Seismic Design Category = D**

Note: When $S_1$ is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

---

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

## References


1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

# Attachment E

# Geotechnical Data


0 500 FEET

# LEGEND

- FACILITY AREA BOUNDARY
- EXISTING DITCH LINE
- PROPOSED CONSOLIDATION AREA
- PROPOSED EXCAVATION AREA
- EXISTING STOCKPILED SLAG BOUNDARY
- STOCKPILED SLAG
- SOIL STOCKPILE ON TOP OF SLAG
- EXISTING TRENCH LOCATION
- PRE DESIGN INVESTIGATION TRENCH LOCATION
- ⊗ TEST PIT

CTP CONSOLIDATION TEST PIT
RSP RESIDENTIAL SOIL STOCKPILE PIT
ETP EXCAVATION AREA TEST PIT

NOTE:
FIGURE BASED ON INFORMATION INCLUDED IN RI/FS FIGURES BY ENTACT MARCH 2009

BLUE TEE CORP.
OLD AMERICAN ZINC SITE
FAIRMONT CITY, ILLINOIS
**PRE DESIGN INVESTIGATION**

**TRENCH & TEST PIT LOCATIONS**

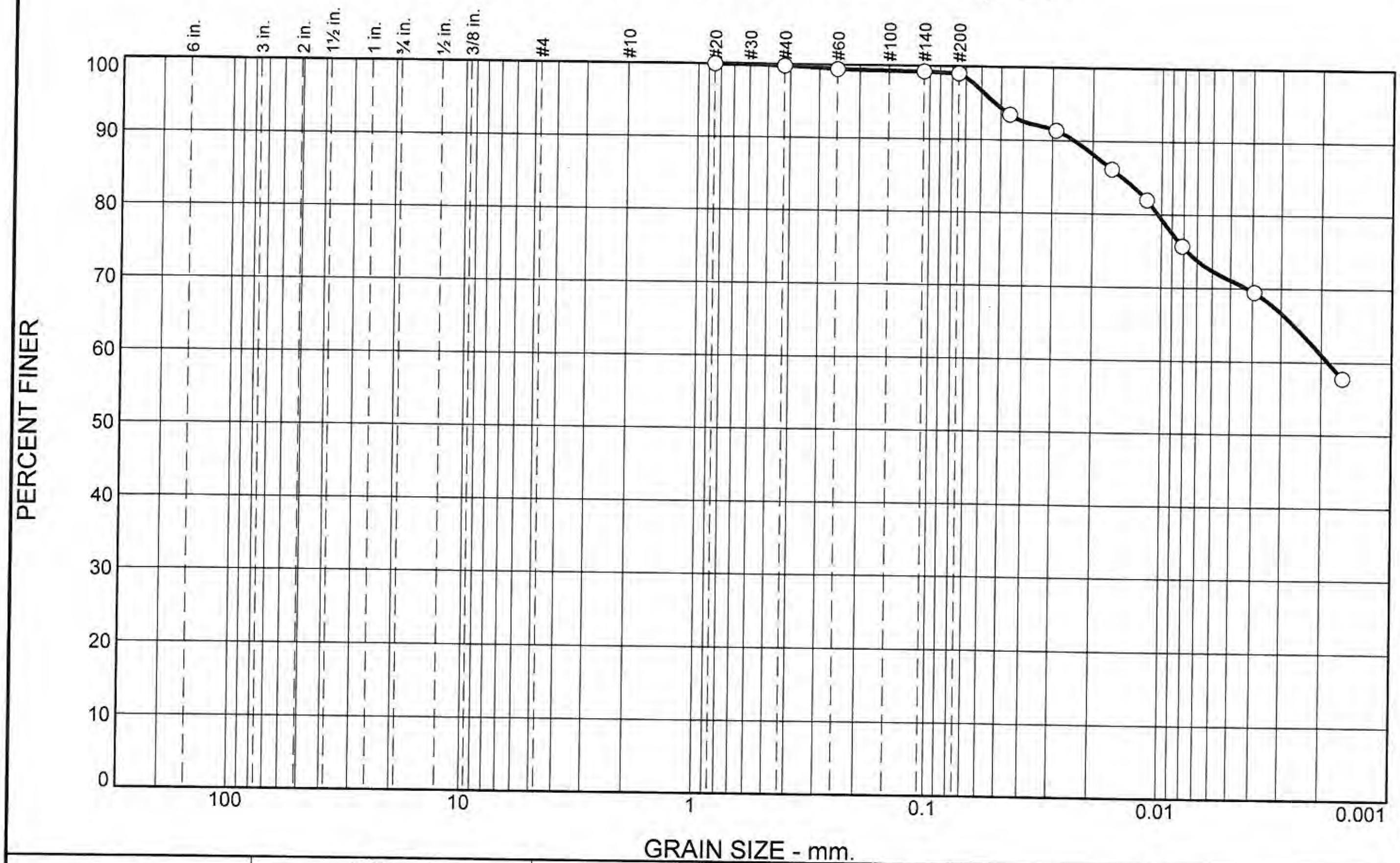
ARCADIS

FIGURE
3

**TABLE 1: CLASSIFICATION TEST DATA**

| LAB NO. | SAMPLE NO. | DEPTH (FT.) | Std. Proctor | | USCS SPECIFI-CATIONS | MECHANICAL ANALYSIS | | | | ATTERBERG LIMITS | | | AVERAGE PERM (CM/SEC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Max Dry Density (pcf) | Optium Moisture Content (%) | | GRAVEL (%) | SAND (%) | SILT (%) | CLAY (%) | LIQUID LIMIT (%) | PLASTIC LIMIT (%) | PLAST-ICITY INDEX | |
| 5245 | TR-11:G001 | | 88.2 | 28.2 | CH | 0 | 1 | 38 | 61 | 82 | 25 | 57 | 3.1E-08 |
| 5248 | ETP-1:G003 | | 95.0 | 23.3 | CH | 0.8 | 10.1 | 30.8 | 58.3 | 68 | 20 | 48 | 2.9E-08 |
| 5249 | ETP-1:G004 | | 89.8 | 27.0 | CH | 0 | 2.2 | 42 | 55.8 | 76 | 25 | 51 | 5.2E-08 |
| 5250 | ETP-2:G005 | | 84.8 | 30.4 | MH | 0 | 2.5 | 36.6 | 60.9 | 79 | 38 | 41 | 2.9E-08 |
| 5251 | CPT-1:G006 | | 93.0 | 25.8 | CH | 0 | 0.8 | 40.8 | 58.4 | 76 | 35 | 41 | 2.0E-08 |
| 5252 | CTP-2:G007 | | 93.6 | 25.0 | CH | 0 | 2 | 52.4 | 45.6 | 67 | 29 | 38 | 4.8E-08 |

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 0 | 0 | 0 | 0 | 1 | 38 | 61 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #20 | 100 | | |
| #40 | 100 | | |
| #60 | 99 | | |
| #140 | 99 | | |
| #200 | 99 | | |

* (no specification provided)

**Material Description**

GRAY BROWN FAT CLAY

**Atterberg Limits**

PL= 25 LL= 82 PI= 57

**Coefficients**

$D_{90}$= 0.0239 $D_{85}$= 0.0148 $D_{60}$= 0.0019
$D_{50}$= $D_{30}$= $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= CH AASHTO= A-7-6(66)

**Remarks**

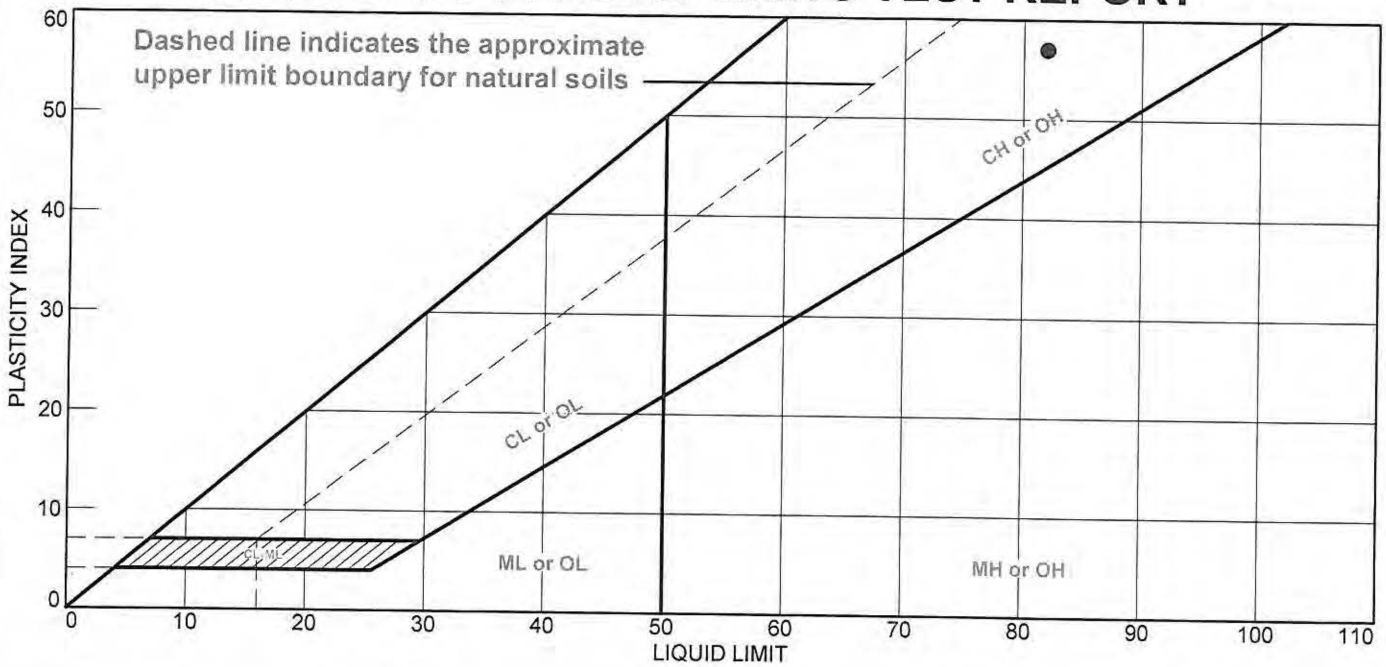
**Source of Sample:** TR-11
**Sample Number:** G001

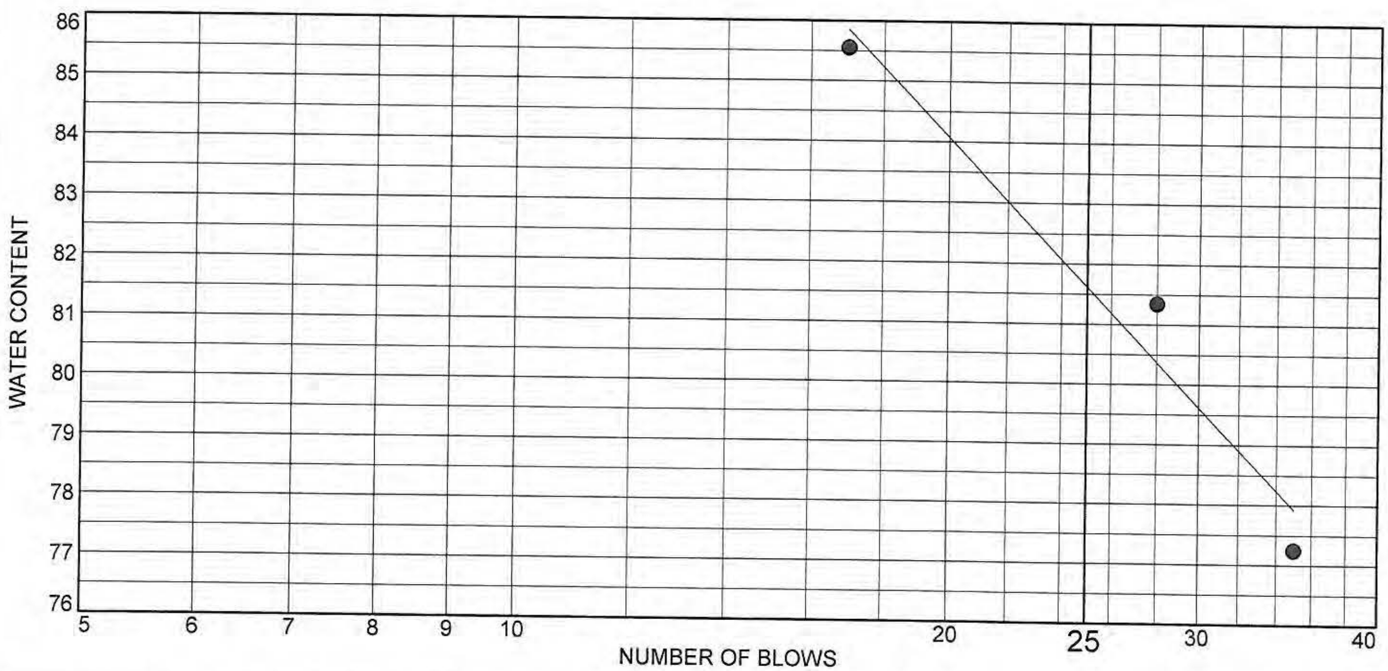
**Date:** 7-15-15

| | |
|---|---|
| **Terracon, Inc.** Cincinnati, Ohio | **Client:** ARCADIS US Inc.<br>**Project:** OLD AMERICAN ZINC SITE<br>**Project No:** N1155153 **Exhibit** 5245 |

**Tested By:** DR **Checked By:** GS

# LIQUID AND PLASTIC LIMITS TEST REPORT




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | GRAY BROWN FAT CLAY | 82 | 25 | 57 | 100 | 99 | CH |

**Project No.** N1155153 **Client:** ARCADIS US Inc.

**Project:** OLD AMERICAN ZINC SITE

**Source of Sample:** TR-11
**Sample Number:** G001

**Remarks:**

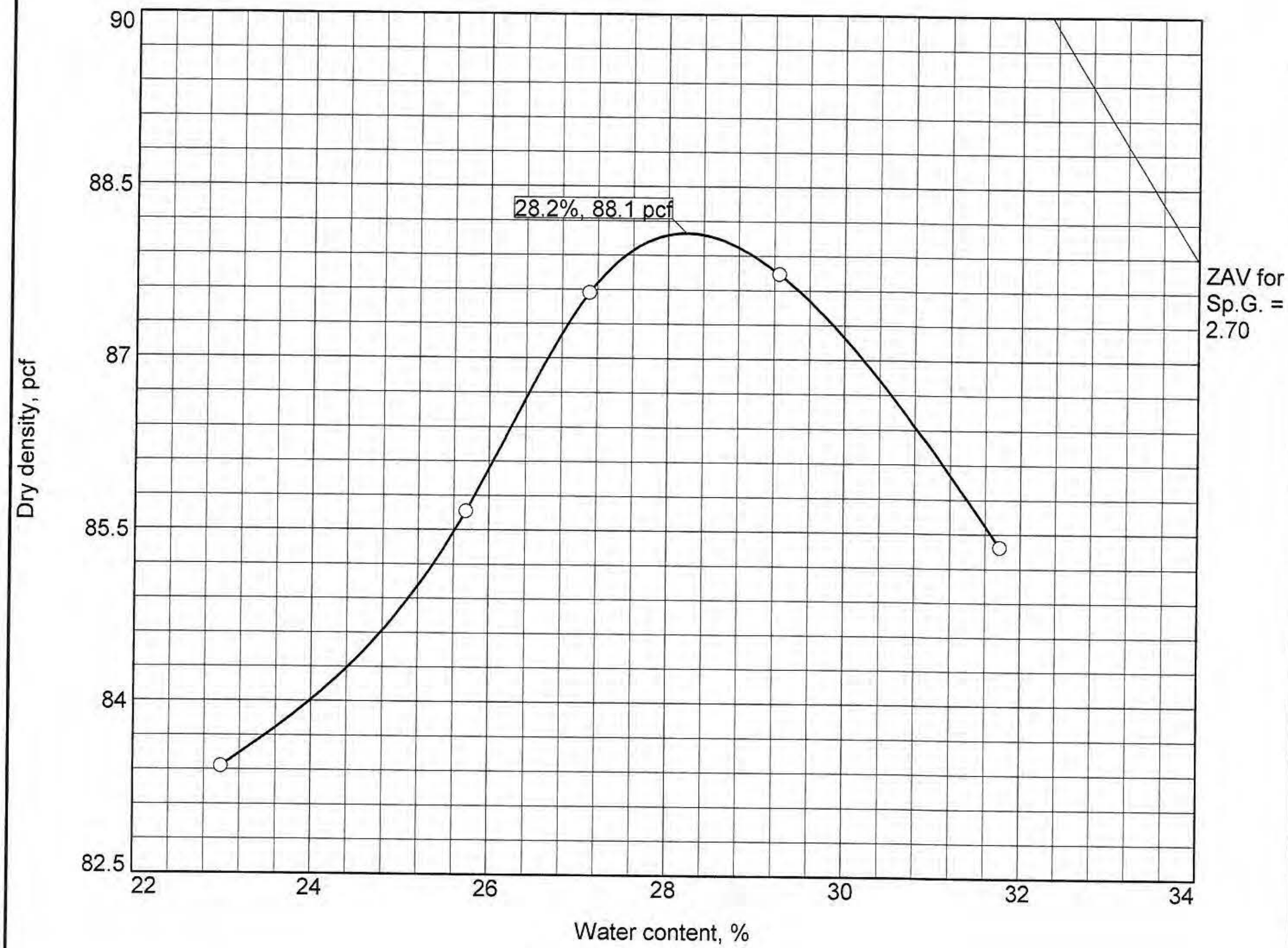
## Terracon, Inc.

Cincinnati, Ohio

**Exhibit** 5245

**Tested By:** JB **Checked By:** GS

# COMPACTION TEST REPORT




Test specification: ASTM D 698-07 Method A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > #4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| | CH | A-7-6(66) | 40.7 | 2.70 | 82 | 57 | 0.0 | 99 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 88.1 pcf<br>Optimum moisture = 28.2 % | GRAY BROWN FAT CLAY |

**Project No.** N1155153 **Client:** ARCADIS US Inc.
**Project:** OLD AMERICAN ZINC SITE

○ **Source of Sample:** TR-11 **Sample Number:** G001

**Remarks:**

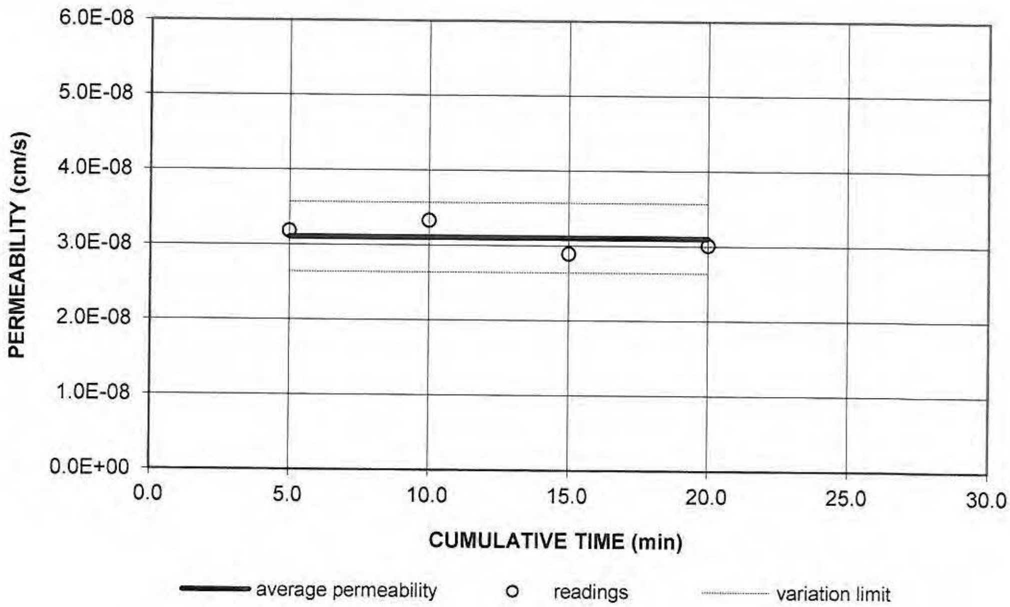
## Terracon, Inc.

**Cincinnati, Ohio**

**Exhibit** 5245

**Tested By:** MRE **Checked By:** GS

# FLEXIBLE WALL PERMEABILITY TEST




Test Specification: ASTM D 5084 Method F

| Fluid Temp. (°C) | Elapsed Time (min.) | Cumulative Time (min.) | Gradient (cm-Hg) | Calculated Permeability (cm/sec) | Average Permeability (cm/sec) |
|---|---|---|---|---|---|
| 21.00 | 5.00 | 5.00 | 12.60 | 3.18E-08 | **3.1E-08** |
| 21.00 | 5.00 | 10.00 | 12.04 | 3.33E-08 | |
| 21.00 | 5.00 | 15.00 | 11.58 | 2.89E-08 | |
| 21.00 | 5.00 | 20.00 | 11.11 | 3.01E-08 | |

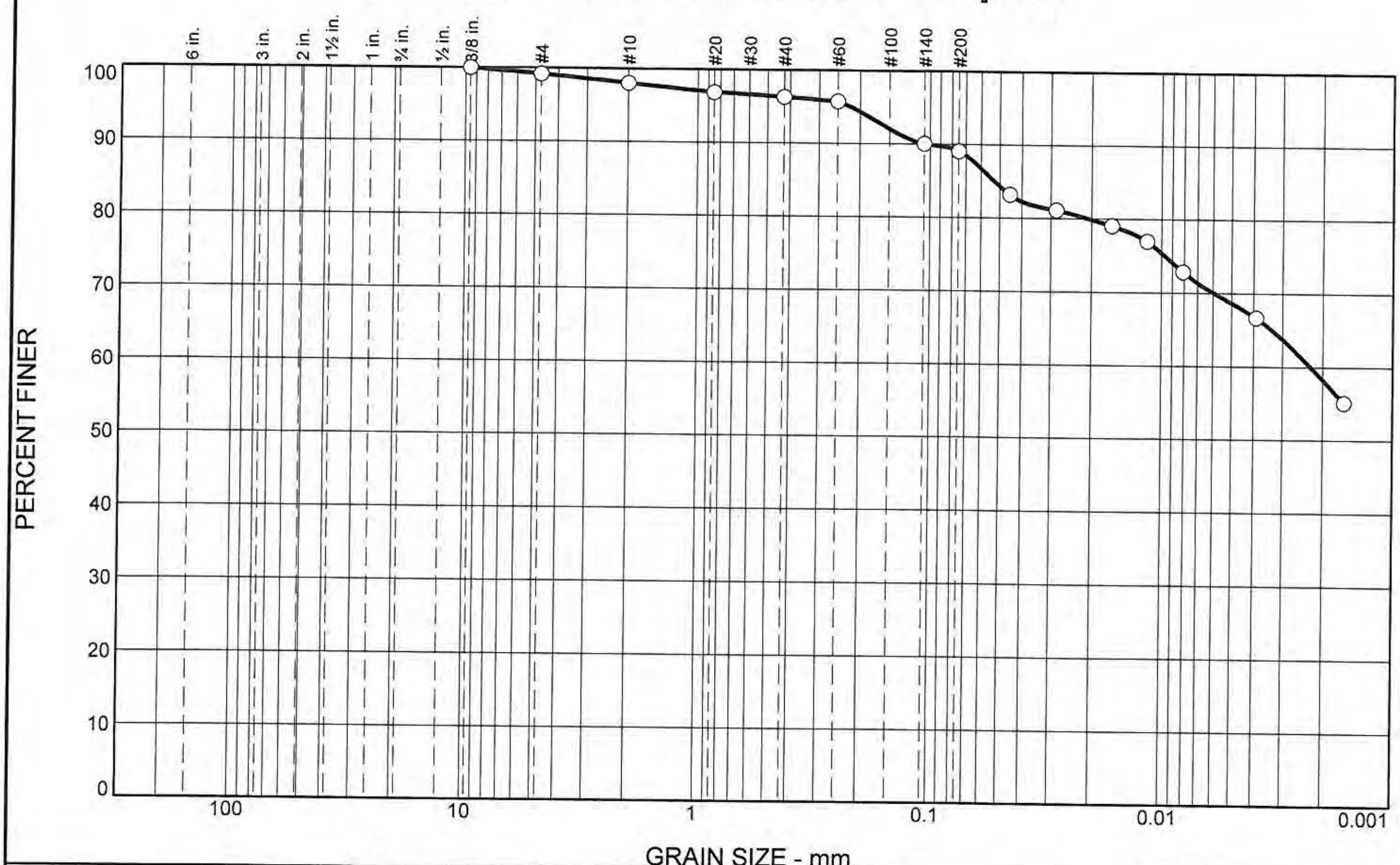
| Compaction Data | | Sample Data | Initial | Final |
|---|---|---|---|---|
| Proctor (pcf) | 88.1 | Specimen Height, (inches) | 3.00 | 3.04 |
| Opti. M.C., (%) | 28.2 | Specimen Diameter, (inches) | 4.00 | 4.00 |
| Comp. Method | | Specimen Volume, (cu. In.) | 37.68 | 38.18 |
| % Recompct. | 95.0 | Moisture Content, (%) | 28.22 | 36.79 |
| Test Pressures (psi) | | Percent Saturation (%) | 75.20 | 95.49 |
| Backpressure | 90.00 | Wet Mass Density (pcf) | 107.30 | 112.96 |
| Cell pressure | 93.00 | Dry Mass Density (pcf) | 83.68 | 82.58 |
| **Eff. Stress** | **3.00** | Void Ratio | 1.01 | 1.04 |
| Specific Gravity | 2.70 | Calculated Porosity, % | 50.33 | 50.99 |

USCS SG Assumed LL PI

Permeant Used: WATER Remarks GRAY BROWN FAT CLAY

| | | | |
|---|---|---|---|
| Project Name | Old American Zinc Site | Tested by FCE | Reviewed by TGG |
| Client | Arcadis W.O.# N1155153 | | |
| Sample Number | TR-11:G001 | **FLEXIBLE WALL PERMEABILITY TEST** | |
| Sample Location | | Terracon | |
| Date | 7/15/2015 Lab No. 5245 | | |

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 0 | 1 | 1 | 2 | 7 | 31 | 58 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| .375 | 100 | | |
| #4 | 99 | | |
| #10 | 98 | | |
| #20 | 97 | | |
| #40 | 96 | | |
| #60 | 96 | | |
| #140 | 90 | | |
| #200 | 89 | | |

* (no specification provided)

**Material Description**

GRAY FAT CLAY

**Atterberg Limits**

PL= 20 LL= 68 PI= 48

**Coefficients**

$D_{90}$= 0.1051 $D_{85}$= 0.0527 $D_{60}$= 0.0023
$D_{50}$= $D_{30}$= $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= CH AASHTO= A-7-6(46)

**Remarks**

**Source of Sample:** ETP-1
**Sample Number:** G003

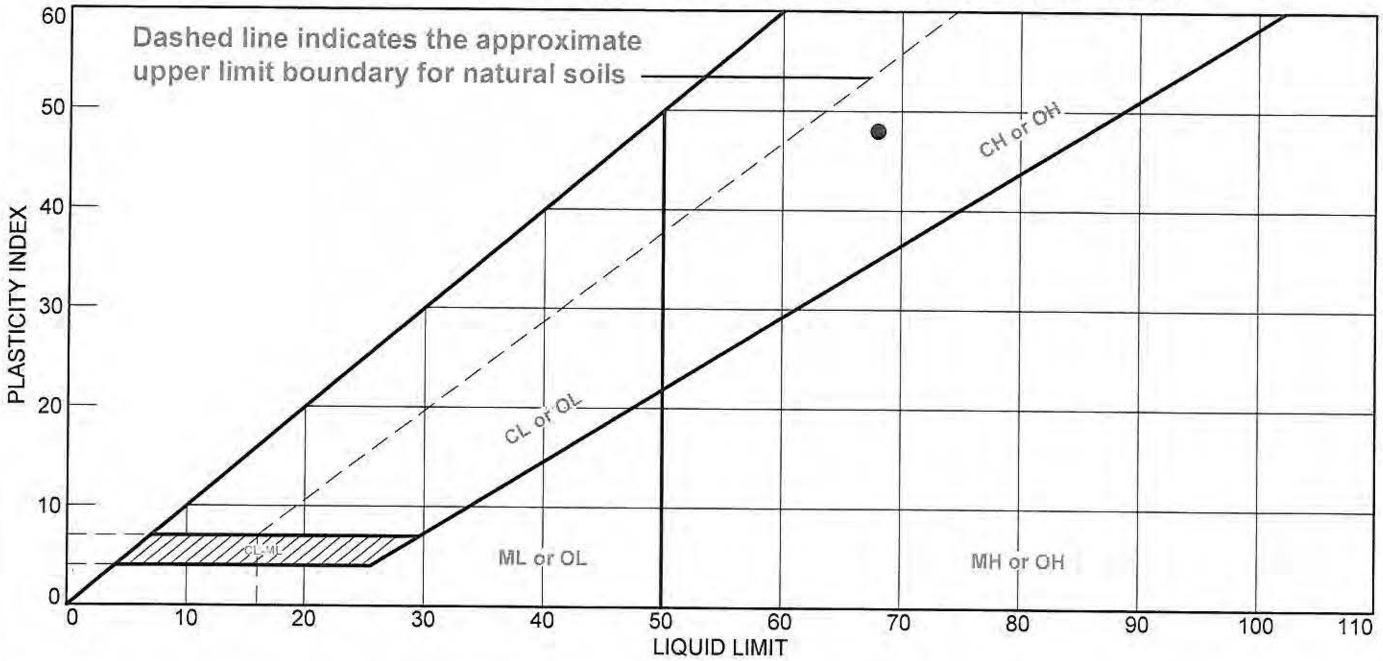
**Date:** 7-15-15

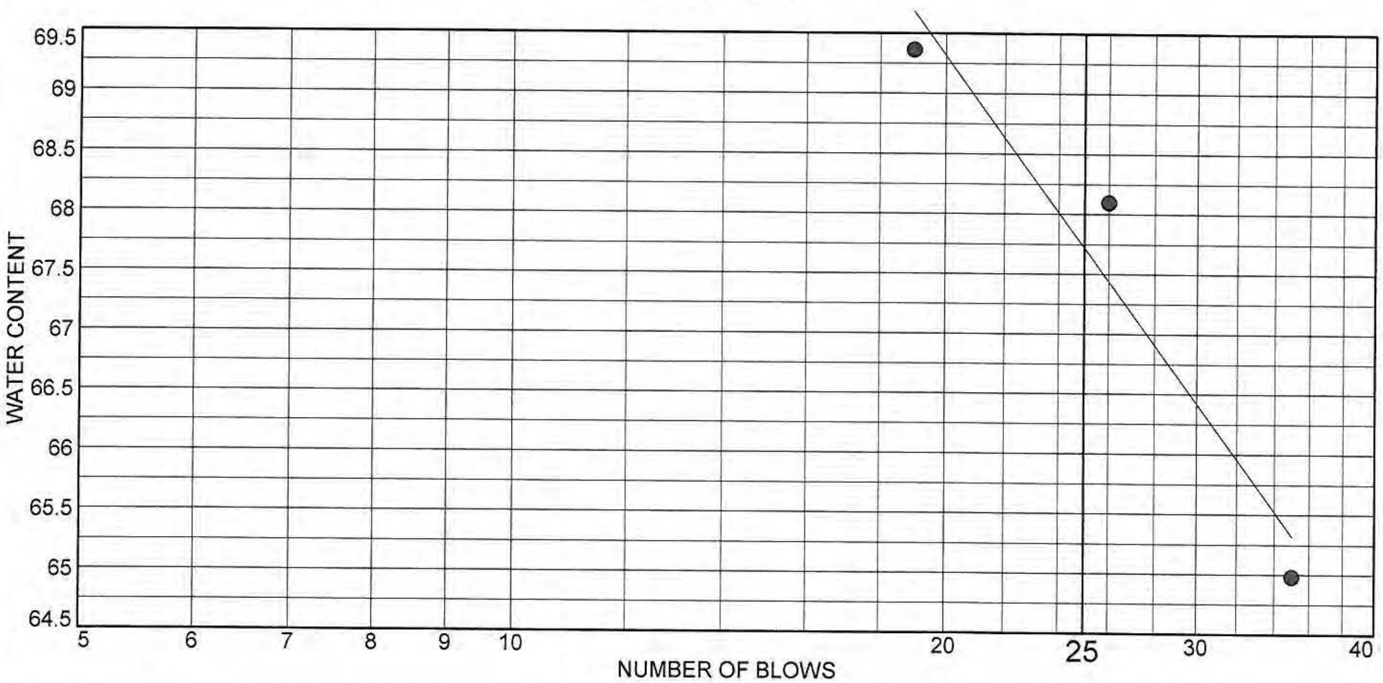
**Terracon, Inc.**
Cincinnati, Ohio

**Client:** ARCADIS US Inc.
**Project:** OLD AMERICAN ZINC SITE
**Project No:** N1155153 **Exhibit** 5248

**Tested By:** DR **Checked By:** GS

# LIQUID AND PLASTIC LIMITS TEST REPORT




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | GRAY FAT CLAY | 68 | 20 | 48 | 96.3 | 89.1 | CH |

**Project No.** N1155153 **Client:** ARCADIS US Inc.

**Project:** OLD AMERICAN ZINC SITE

**Source of Sample:** ETP-1
**Sample Number:** G003

**Remarks:**

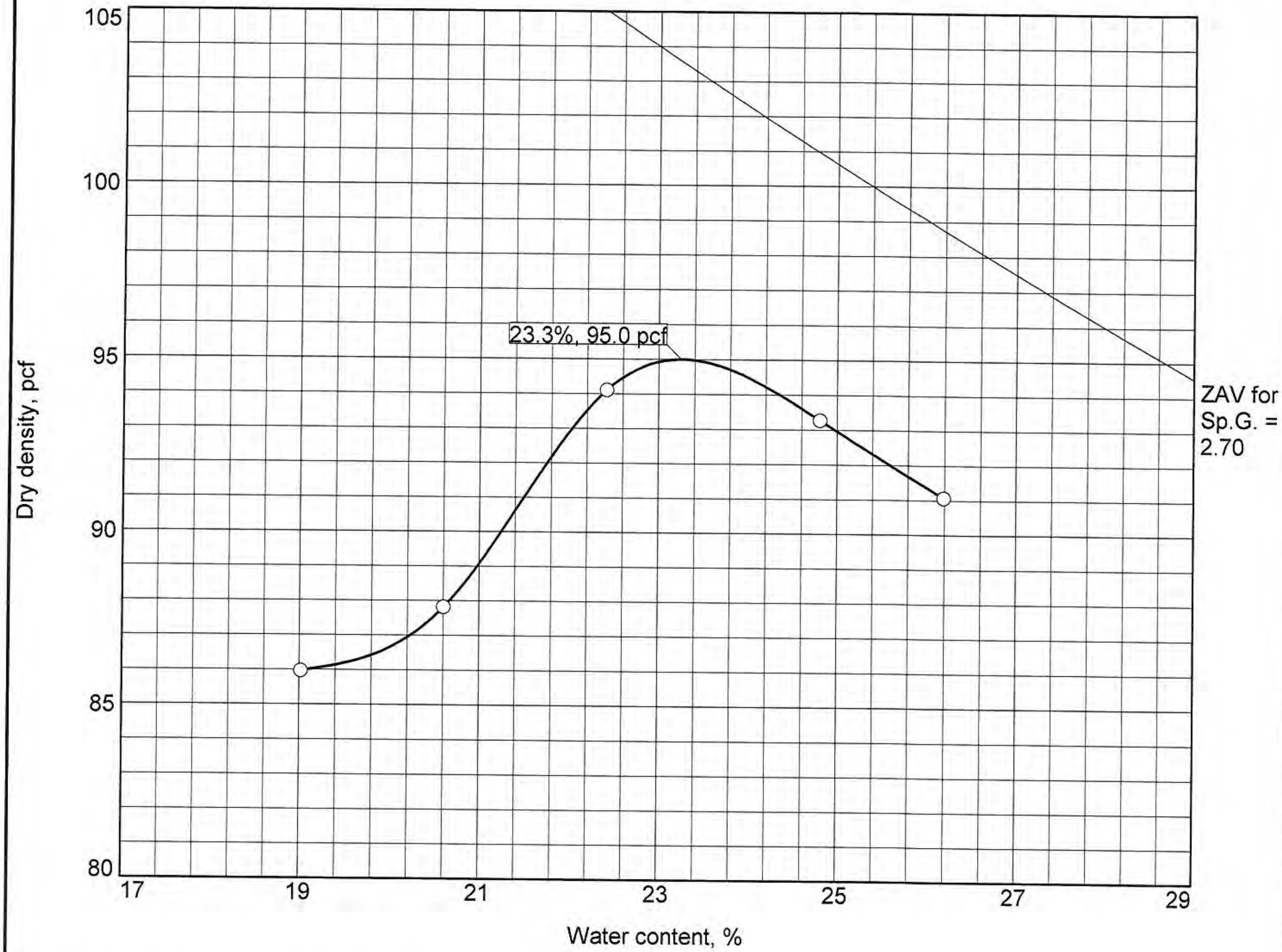
## Terracon, Inc.

**Cincinnati, Ohio**

**Exhibit** 5248

**Tested By:** JB **Checked By:** GS

# COMPACTION TEST REPORT




Test specification: ASTM D 698-07 Method A Standard

| Elev/ Depth | Classification | | Nat. Moist. | Sp.G. | LL | PI | % > #4 | % < No.200 |
|---|---|---|---|---|---|---|---|---|
| | USCS | AASHTO | | | | | | |
| | CH | A-7-6(46) | 33.2 | 2.70 | 68 | 48 | 0.8 | 89.1 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Maximum dry density = 95.0 pcf<br>Optimum moisture = 23.3 % | GRAY FAT CLAY |

**Project No.** N1155153 **Client:** ARCADIS US Inc.

**Project:** OLD AMERICAN ZINC SITE

○ **Source of Sample:** ETP-1 **Sample Number:** G003

**Remarks:**

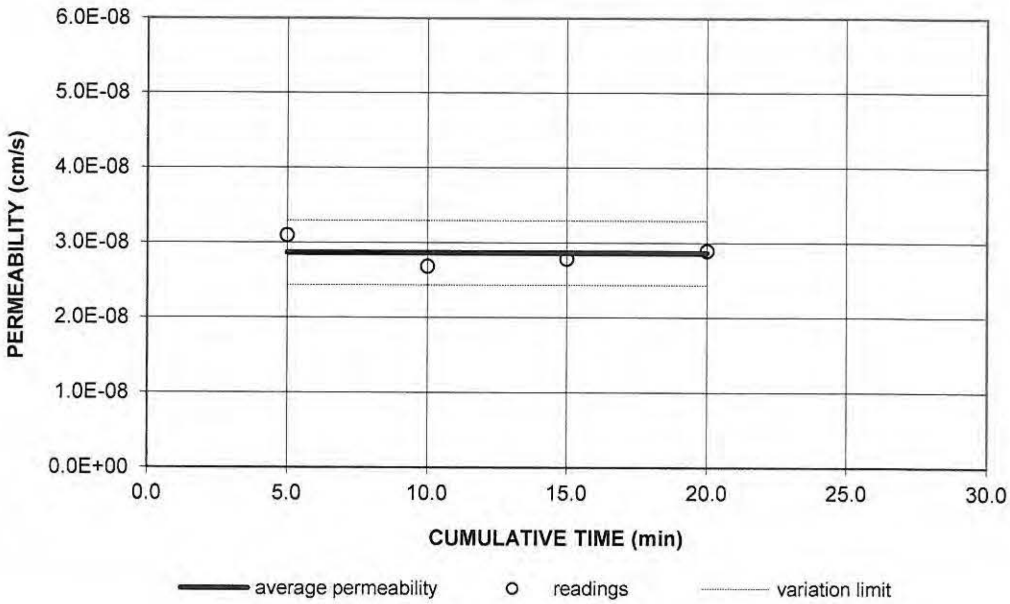
## Terracon, Inc.

**Cincinnati, Ohio**

**Exhibit** 5248

**Tested By:** AW **Checked By:** GS

## FLEXIBLE WALL PERMEABILITY TEST




Test Specification: ASTM D 5084 Method F

| Fluid Temp. (°C) | Elapsed Time (min.) | Cumulative Time (min.) | Gradient (cm-Hg) | Calculated Permeability (cm/sec) | Average Permeability (cm/sec) |
|---|---|---|---|---|---|
| 21.00 | 5.00 | 5.00 | 12.97 | 3.09E-08 | **2.9E-08** |
| 21.00 | 5.00 | 10.00 | 12.50 | 2.68E-08 | |
| 21.00 | 5.00 | 15.00 | 12.04 | 2.78E-08 | |
| 21.00 | 5.00 | 20.00 | 11.58 | 2.89E-08 | |

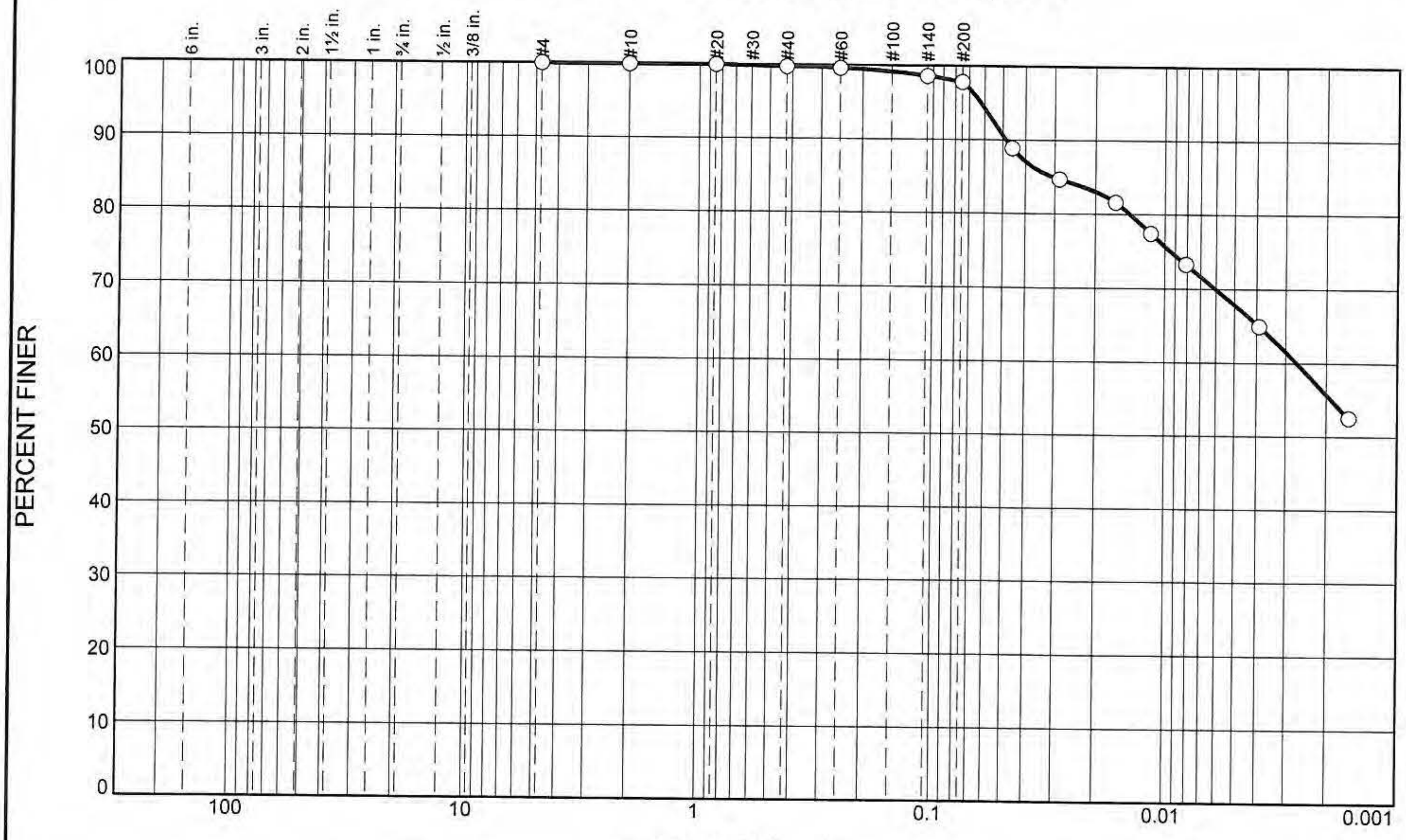
| Compaction Data | | Sample Data | Initial | Final |
|---|---|---|---|---|
| Proctor (pcf) | 95.0 | Specimen Height, (inches) | 3.00 | 3.05 |
| Opti. M.C., (%) | 23.3 | Specimen Diameter, (inches) | 4.00 | 4.00 |
| Comp. Method | | Specimen Volume, (cu. In.) | 37.68 | 38.31 |
| % Recompct. | 94.8 | Moisture Content, (%) | 23.55 | 32.01 |
| Test Pressures (psi) | | Percent Saturation (%) | 73.03 | 95.81 |
| Backpressure | 90.00 | Wet Mass Density (pcf) | 111.27 | 116.94 |
| Cell pressure | 93.00 | Dry Mass Density (pcf) | 90.06 | 88.58 |
| **Eff. Stress** | **3.00** | Void Ratio | 0.87 | 0.90 |
| Specific Gravity | 2.70 | Calculated Porosity, % | 46.54 | 47.42 |

USCS SG Assumed LL PI

Permeant Used: WATER Remarks GRAY FAT CLAY

| | | | |
|---|---|---|---|
| Project Name | Old American Zinc Site | Tested by FCE | Reviewed by TGG |
| Client | Arcadis W.O.# N1155153 | | |
| Sample Number | ETP-1:G003 | FLEXIBLE WALL PERMEABILITY TEST | |
| Sample Location | | Terracon | |
| Date | 7/17/2015 Lab No. 5248 | | |

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 0 | 0 | 0 | 0 | 2 | 42 | 56 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| #4 | 100 | | |
| #10 | 100 | | |
| #20 | 100 | | |
| #40 | 100 | | |
| #60 | 100 | | |
| #140 | 99 | | |
| #200 | 98 | | |

* (no specification provided)

**Material Description**

GRAY FAT CLAY

**Atterberg Limits**

PL= 25 LL= 76 PI= 51

**Coefficients**

$D_{90}$= 0.0485 $D_{85}$= 0.0303 $D_{60}$= 0.0027
$D_{50}$= $D_{30}$= $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= CH AASHTO= A-7-6(58)

**Remarks**

**Source of Sample:** ETP-1
**Sample Number:** G004

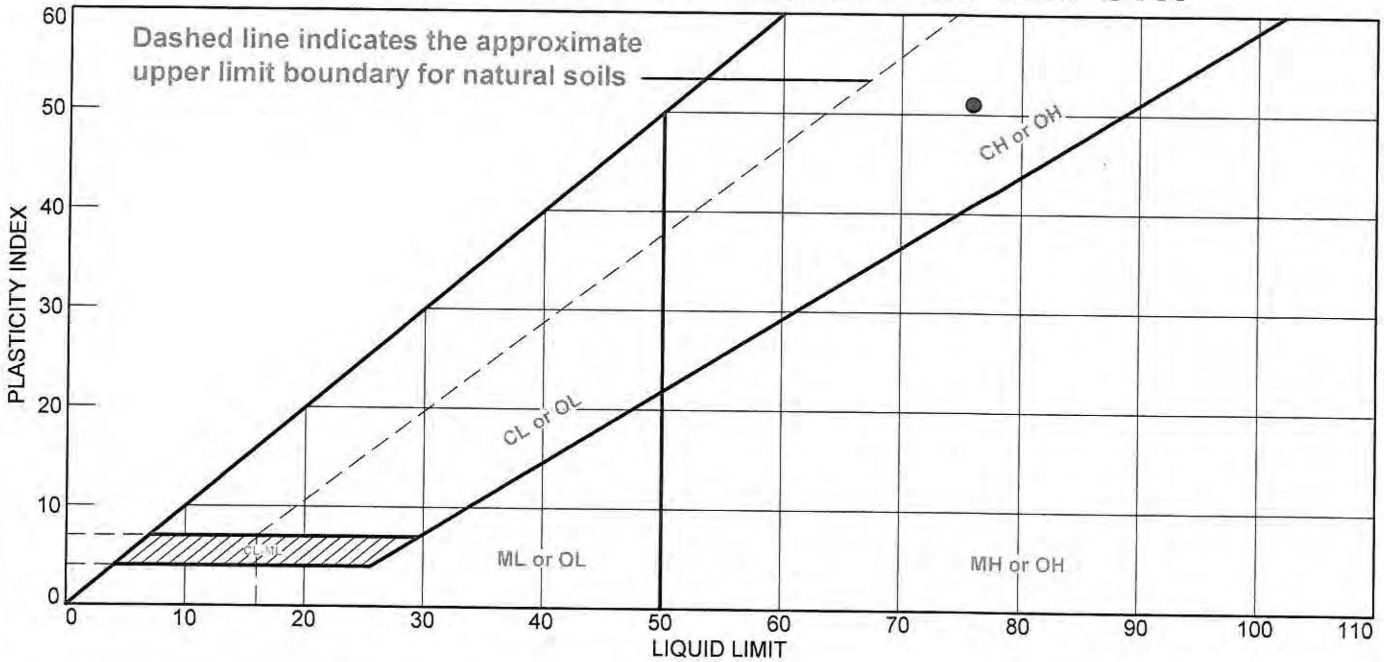
**Date:** 7-15-15

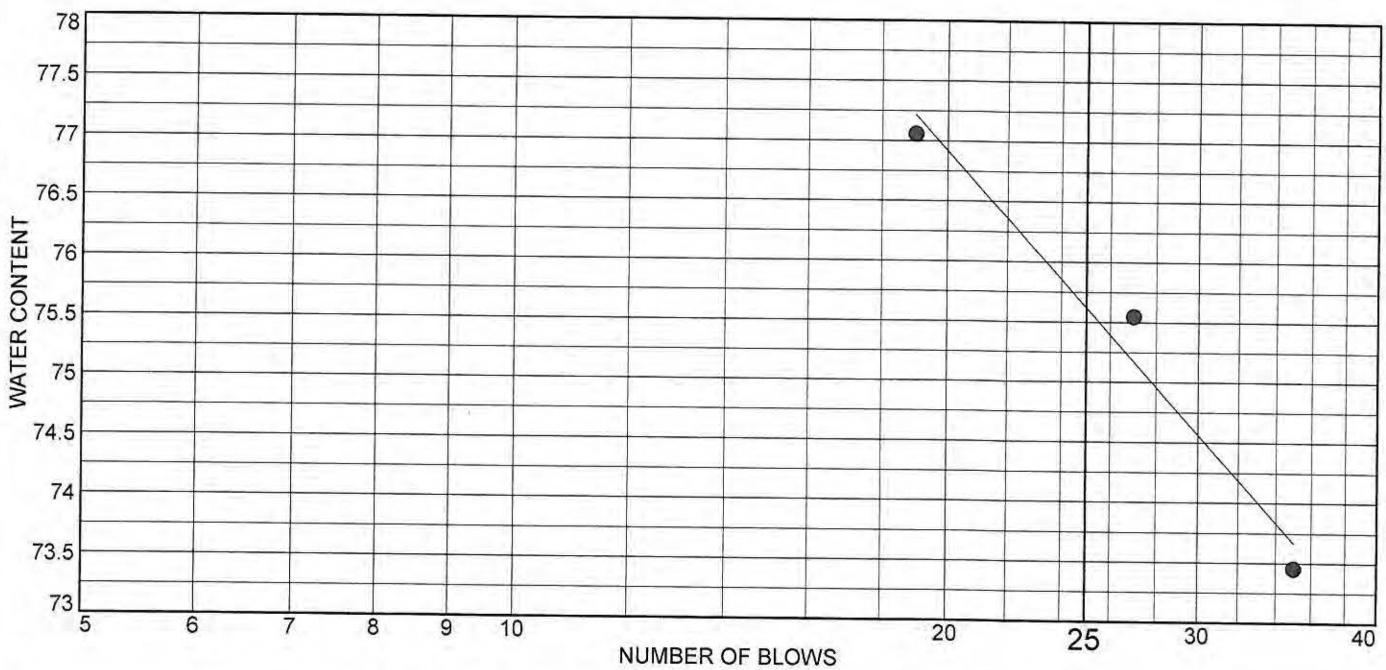
**Terracon, Inc.**
Cincinnati, Ohio

**Client:** ARCADIS US Inc.
**Project:** OLD AMERICAN ZINC SITE
**Project No:** N1155153 **Exhibit** 5249

**Tested By:** DR **Checked By:** GS

# LIQUID AND PLASTIC LIMITS TEST REPORT




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | GRAY FAT CLAY | 76 | 25 | 51 | 99.8 | 97.8 | CH |

**Project No.** N1155153 **Client:** ARCADIS US Inc.

**Project:** OLD AMERICAN ZINC SITE

**Source of Sample:** ETP-1
**Sample Number:** G004

**Remarks:**

## Terracon, Inc.

Cincinnati, Ohio

**Exhibit** 5249

**Tested By:** JB **Checked By:** GS